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Contents

Contents of previous issues can be found by consulting the Industrial Arts Index at your library

• Special Articles

Textiles of Tomorrow..... 737
Kenneth H. Barnard

Soluble Chromium Derivatives of Dyestuffs..... 741
James L. Boyle

Cheap Power and Heat for Dyeing Plants..... 744
C. H. S. Tupholme

Spot Testing in Textile Analysis..... 757
Erwin J. Saxl

• Departments

Open Forum 753

Trade Notes—New Products..... 758

Index to Volume 28.....follows page P748

• Proceedings of the American Association of Textile Chemists and Colorists

Calendar of Coming Events..... P745

Organizing a Dyeing and Finishing Plant for Synthetic Piece Goods P746
P. J. Wood

One Hundred and Twenty-fifth Council Meeting..... P751

Meeting, Philadelphia Section..... P752

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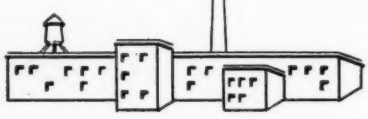

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AMERICAN
DYESTUFF REPORTER

VOLUME 28 DECEMBER 25, 1939 NUMBER 26

Textiles of Tomorrow*

KENNETH H. BARNARD**

THE central thought in my talk tonight contradicts one of the best known precepts of the Bible. You will recall in Matthew, Chapter VI, Verse 34, the good book tells us "take therefore no thought of the morrow, sufficient unto the day is the evil thereof." Between the bloody war across the ocean and the usual stink of some American city politics, I agree on the sufficiency of present day evils, but even so, we would like to call your attention to some thought of the morrow.

Now the future that immediately concerns us is quite an individual matter and while for junior such thoughts may center about a coming foot-ball game, my own cerebral excitations revolve about the future of textiles and this therefore, is our subject this evening.

Of course, textiles in general are an old story. I understand Adam and Eve were more interested in fruit than in clothes. Since that time, with the exception of a few nudists, most people would prefer to go without fruit than without clothes, at least in our New England climate. With so many breath-taking changes in the mechanical and electrical world, the telephone, radio, automobile and airplane, all developed within our memory, it may come as a bit of a surprise that equally revolutionary changes are appearing in textiles.

The whole great vault of the heavens of the ancient world were held up for years on the broad shoulders of Atlas, until a new-comer, Hercules, relieved him while searching for the golden apples of the Hesperides. And so within even the short space of my memory, the ancient pillars of the textile world, wool, cotton, silk and linen are being shouldered aside by the modern Hercules in the shape of new synthetic textile fibers. Your chance purchase of a rayon slip like a pebble dropped in a still pool is causing ever expanding ripples which are being felt away across the Pacific. For today, more pounds of rayon are produced than pounds of silk and Japan whose major export material was once silk, has been smart enough to shift so rapidly to rayon production that she stands today as one of the world's greatest rayon manufacturer. Until this year silk still reigned supreme in women's silk stockings, as no other fiber real or artificial, equalled it in strength and elasticity, but the stockings of tomorrow will be made of tomorrow's fiber. Nylon is one of these, a product of a great chemical manufacturer in your own state of New Jersey, because this synthetic yarn is unique in possessing these essential properties to a high degree. And perhaps even more remarkable is the fact that this substitute for silk worm's filament can be made of such common inorganic materials as are found right around New Jersey, coal, air and water.

Wool is the next natural fiber that is feeling the rising tide of synthetics, that sturdy defender of man's warmth and wear has been entirely replaced in some of the "Ersatz" countries, notably Italy with lanital, an artificial wool made from skim milk. In this particular case, however, the newcomer lacks many of the worthy qualities of its older rival, but the plea of national self sufficiency, the exigencies of war and war's blockades, together with the fact that the newer fibers may be distinctly cheaper than wool will certainly accelerate this shift in 1940. I do not need to be the seventh son of a seventh son to prophesy that Mr. Average Man in the center of this audience will be wearing a spun rayon suit next summer just as his good wife beside him has been wearing spun rayon dresses now for several seasons.

Still another pillar of the modern textile Hercules is glass yarn spun fifteen times finer than a human hair, softer and stronger. While not recommended for clothing, its beautiful texture, drape and weight, make it ideal for fire-proof curtains and draperies. It can even be printed, so when you take in tomorrow's gift from contented cows, reflect that there is enough casein in a quart of milk to make you a woolen necktie and enough glass in the milk bottle itself to make hundreds of miles of silk-like yarn for your draperies. It is hard to visualize the

*Presented at meeting, North Jersey Section, American Chemical Society.

**Chief Chemist, Pacific Mills.

possibility that thousands of oriental farmers growing mulberries and raising silk worms in far away Japan and China may join the army of the unemployed while other thousands here in Jersey may find new employment in taking coal, air and water to make nylon or literally the sands of the sea to make spun glass fabrics. And yet these changes and others are upsetting the old order in today's textiles and are the forerunners of the textiles of tomorrow.

Having considered some of the changes in textile raw materials, we next come to equally revolutionary changes possible tomorrow in the actual fabrication of our goods. For several centuries, the standard procedure of transforming any fiber to a fabric was first a cleansing operation, then an individual straightening of each fiber in a cotton card or woolen comb, then combining these fibers into thick, soft ropes which were repeatedly pulled down into finer and finer yarns while the required twist was incorporated in them until the final, smooth, strong yarn was produced. These yarns were then divided and part of them wound on a huge spool or warp beam and pulled through a loom where the warp yarns were alternately raised and lowered to allow the other set of yarns or filling yarns which had been wound on bobbins, to be slipped back and forth between them with the flying shuttles. Tomorrow's textiles may eliminate 90 per cent of this work and machinery by taking a clean fiber in a thin gossamer web off the cotton carding machines and combining sheets of this cobweb material until the cloth is built up without any spinning, twisting, reeling or weaving operations. The final result is something between paper and felt, but stronger than either. The possibilities in this sort of work are so astounding, we hesitate to predict what their future may be, but at least you in New Jersey will be interested to know that this research is a product of your own state. Perhaps instead of calling this article "textiles of tomorrow," I should refer to it as "the day after tomorrow."

Having considered future trends in fibers and possible changes in textile manufacturing, let us go a step further and consider the new fabrics of tomorrow. Such developments seem to follow along two lines of advance.

1. New industrial fabrics which will probably be more interesting to the men in the audience.

2. New dress fabrics which may prove more fascinating to the ladies.

CRINKLE CREPES

There is quite a variety of cloth sold to women under the name of crinkle crepes and there are two general methods of making them. First, by alternating the direction of the twist in the yarns used in weaving, so that a certain number of threads have a righthand twist followed by a certain number having the reverse or lefthand twist. Such a cloth, when wet out and finished takes on a crepey or seersucker appearance due to the cloth kinking up from the unwinding action of the hard twisted yarns. At home on Hallowe'en, our small boys string a heavy button on a double string and by winding it up and unwinding it against a window pane, create a beautiful racket for Hallowe'en. If you care to try this, you can readily see the kinking effect on the thread when twisted hard.

The second general method employs chemicals, usually caustic soda which is printed on the regular flat cloth in stripes or other designs. Where the caustic hits the yarns, they tend to contract, thus producing the crinkle or plisse effect where there is no caustic. This second method allows a great variety of effects and patterns and utilizes a cheaper grey cloth construction and for these reasons is the one most generally used on cottons. Until within a few months, if a crinkle was wanted on rayon, it could only be obtained by using differently twisted yarns in the weave room, but research chemists have recently perfected a rayon crinkle or seersucker effect by the second or chemical method. We believe this will be a very popular number in the textiles of tomorrow. It combines a rich silky smoothness of real silk with a crinkle effect which is proof against washing and dry-cleaning.

BUFFING WHEEL CLOTHS

Turning now to the industrial side of the picture, we find a large consumption of cotton cloth by various metal fabricators who finish their products by buffing them to get a high luster. For example, the automobile manufacturers use up great quantities of cloth in buffing their lamps, bumpers, grills and hardware on the cars. All silverware is buffed and so are many of the brass, bronze and other metal objects that require a shiny finish. All this work is done on buffing wheels which are built up in layers of circular sections of cloth clamped together in a rapidly spinning wheel. The cloth acts merely as a flexible carrier for a polishing compound, an abrasive set in wax. Naturally, the cloth buff is worn away rapidly as the wheel is forced against the metal part to be polished. It seemed possible from a research standpoint that the life of such cloths might be improved. First, a method of testing buffing cloths in the laboratory was worked out in cooperation with the Massachusetts Institute of Technology, so that the cloth's resistance to abrasion in actual use might be predicted accurately in the laboratory. Next, various chemical treatments were tried out, discarding those which showed no promise and tracking down further those which helped to raise the abrasion resistance. It was finally found possible to guarantee a 50 per cent increase in the life of a buffing wheel fabric through a relatively simple and patented chemical treatment. The only difficulty with the treatment is that on some soft metals such as silver, it is really too good and where a raised design, as for instance on the back of a fork, is to be polished, this particular finish may cut the design right off instead of merely polishing it. However, instead of a detriment, we regard this merely as another illustration of the cloth's superior abrasive power, perhaps on the theory that every knock is a boost! In

this development we have had the cooperation of another New Jersey concern, Hanson, Van Winkle Munning of Matewan, a large producer of electroplating equipment.

PAMILLA SILVER CLOTH

The next development is one that appeals to both the man and woman of the house, that is, if the man is one of those unfortunates who has to shine the family silver. One of the gems of wisdom which I picked up in my student days was that inventors were the laziest of men since they were always looking for a still easier way of doing something. This may explain the patent application on this subject which while granted a few years ago, still furnishes another illustration of the role of the chemist in textiles of tomorrow. As you all no doubt know, the tarnishing of silver is due to sulfur gases present in the atmosphere, so obviously the problem of preventing tarnishing was therefore, merely that of keeping these gases away from the silver. You might think an air-tight bag would do the trick, but rubber isn't satisfactory as rubber carries considerable sulphur itself, and besides, how are you going to get the silver into the bag without getting any air in at the same time? The more likely way would be to treat the bag so that it would selectively stop the sulfur gases just like the gas masks stop poisonous gases. A flannel saturated with almost any heavy metal salt would work, but you don't want to use a poisonous metal like lead in contact with silver forks and spoons that might go in the baby's mouth. You would also probably prefer a metal with a light colored sulfide like zinc than one with a black sulfide like iron on esthetic grounds. I think we have tried them all, but to condense several years work into a few sentences, we found that while most metals work for a while, in a few months' time, the sulfur which they caught and concentrated on the bag, was passed along to the silverware within and the cure was really worse than the disease. So we finally had to fight fire with fire and patented the use of silver itself as the protective medium. In other words, we impregnate the flannel bag with millions of tiny particles of silver which immediately unite with and hold back any sulfur gases in the air before they can reach and tarnish the silverware within. Sufficient silver is used to last a lifetime, judging from practical tests made in Butte, Montana, where one of the world's largest smelters is located and hence an atmosphere particularly high in its sulfur content. In six years in homes in Butte, we found less than 5 per cent of the total silver in Pamilla silver bags used up and that 95 per cent was still available to stop new sulfur gas attacks. On the basis of this and other tests, the Gorham Silver Company uses this material for lining their silver chests.

GLAZED CHINTZ

If you ever lived in England and have experienced the charm of the English countryside, you know without my telling you that one of the reasons their homes are so attractive is the liberal use of glazed chintz, both for curtains and furniture covers. Bright, floral patterns and colors as if taken right out of their gardens are combined with a crisp, smooth, shiny finish, a typical glazed chintz. So popular are these that the English keep some of their mills busy refinishing these curtains, as unfortunately, their luster is a temporary thing and is lost at the first wash-tub. It has been one of the problems of the research chemist over here to produce this same effect in a more lasting or permanent manner, so that the chintz curtains could be washed and ironed repeatedly without losing their luster. Several American textile companies have accomplished this feat through the use of organic synthetic resins. While this particular finish should really be classed as a textile of today rather than tomorrow, it illustrates a trend which will continue to blossom out in new finishes. I refer to the trend of utilizing the new synthetic resins which are crystal clear, insoluble in soap and water and in dry-cleaning solvents in place of the older finishing materials such as starch, oils, softeners, etc., which are gone when the goods are first laundered. Tomorrow's textiles will be softened or stiffened, made resilient, that is crease resistant or crush-proof, made slip-proof, non-fraying, strengthened or stabilized through the use of modern resin finishes. Many of these are so new that the textile mills themselves don't know how best to use them and are awaiting consumer reaction to express itself.

When a softer finish is wanted, but one equally permanent, a different type of resin is used as shown on the rayon satin weave, satin magic, a cloth that has real glamour both in its coloring and its finish.

Tomorrow's customer is going to demand of tomorrow's textiles that they are not only dyed or printed with faster colors, but also that they will not fray, shrink or change in hand or appearance when cleaned or laundered. Many fabrics have one or more of these properties now. Tomorrow you are going to ask for and receive all of them in the same piece of cloth. Perhaps the most difficult to obtain is that of permanency of finish, but I have already shown you finishes of this type made with resin. There is still another way to accomplish the same thing.

As you chemists know, cotton is soluble in cuprammonium solutions, but by modifying the solvent somewhat, it is possible to remove the degradation products of cellulose, the hydro and oxycellulose and leave the pure alpha-cellulose unattacked. This is the basis of the Ridbo patented process which permits obtaining a cleaner, purer, stronger, more lustrous cotton than any previous methods. Cotton yarns are rayonized in the piece. Further it is possible to start an incipient fusion of the yarns where they cross in the woven piece,—thus, partially cementing them together and giving a certain crispness and stiffness to the fabric which will withstand repeated washing without change. For voiles or lawns this is highly desirable and so instead of starching your tea apron of the future for example, you will merely wash it and dry it and it

will be as crisp and clean as it was originally. This process is so new that it is barely on the market under the name of Calmont batiste.

STYLE

We now come to one of the more elusive elements of the textiles of tomorrow, that is style. What is stylish, what constitutes good taste, what will the women of America buy tomorrow? I wish I knew! We maintain a style bureau with some twenty-five people working continually to answer these questions. The average man will dismiss the subject with a shrug of his shoulders as of no particular interest to him, but stop a minute and think this one over. Suppose you took a motor car fresh from the assembly line today, wrapped it in cellophane, locked it away in a vault for ten years where it could neither rust nor corrode and then tried to sell it or give it away to Mr. Average man in 1950. Intrinsically, it is just as good a car as the day it was made, but his friends would howl at him if he drove around in such an old-fashioned car and there would be derisive shouts of "where is your linen duster and goggles?" Of course, in textiles for dress-wear, everyone admits style is 90 per cent of the battle. While I cannot explain why it is so, you ladies know that dresses are some 6" shorter than they were six months ago and while this means a loss of millions of yards to the cloth mills, it also means more volume to the stocking and shoe manufacturer, as these items command more attention as the tide level on dresses recedes.

The head stylist of any textile concern is generally a woman and her job takes her to the Paris openings usually twice a year. With all due respect to Hollywood influence, women's styles generally originate in Paris. Here men and women artists devote their lifetime to creating new effects. Their work is comparable to that of any other artist only they work with cloth instead of stone or canvas. Money and time are distinctly secondary. The creative, artistic spirit is the thing and the French have this to a high degree. What a stylist does is to translate this single artistic effect into a design and a material suitable for machine reproduction by the thousands of pieces on a less expensive fabric that can be sold throughout America. To be successful as a dress fabric, it must have eye appeal, it must hold your attention and while this generally means color, the colors used must be so chosen that they harmonize and strengthen each other and are not merely blobs of paint thrown on a canvas.

It has been said that "seeing is believing" and therefore, I trust seeing at close range some of the new fabrics and designs which the seventeen young girls from your local high school have so attractively modeled, you will have now become convinced of the immense importance of style and good taste to the future of textiles.

I have a half dozen slides here which indicate the mechanics of how we transfer an artist's design on paper to the printed cloth which you buy. Perhaps you will wonder how this can be accomplished. The first slide shows the painted design on cardboard off the artist's easel with his notes and colors along the edge. This may be two feet by three feet and goes first to the sketch-maker who puts it in a huge camera which throws the enlarged image down on the flat table top which he has covered with a zinc plate. He carefully traces the outline of the design on the zinc plate, smoothing up the lines and cutting the design into the zinc with a steel stylus. Next a painter, in this case not a Dutch boy, but an American girl, paints in the outlines so cut with some distinctive color not necessarily the color used by the artist. The colored plates then go to the pentagraph, a machine with a complicated series of levers so fixed that the girl operator following the outline of each design with a pointer on the zinc plate, reproduces this design on the copper printing roll through a series of diamond points connected with the pointer. The machine repeats the design across the width of the roll the proper number of times and at the same time reduces it to the size necessary for printing. The copper roll has previously been given a coat of acid resistant varnish so that the diamond points merely scratch through this to the copper surface beneath. In order to deepen the design sufficiently to hold the dyestuff when used on the printing machine, the copper roll is etched in an acid bath. Naturally, the acid attacks the copper where the surface has been scratched with the diamond, leaving the balance of the roll smooth where it is still protected with its varnish coat. The pentagraph girls copy the design in just one color on just one roll and then proceed to the next color on the second roll as in printing, each color must have its own roll and as high as sixteen colors can be printed at one time on the same piece of cloth. The final step in getting the rolls ready for printing is to remove the acid-proof varnish with a solvent and burnish or polish the roll so that no color will be left on it except where it is engraved. When set up in the printing machine, the colorist must so choose his dyestuffs that they match the original color which the artist had used. The roll is smeared with an excess of color as it revolves in the printing machine, this excess is scraped off with a thin steel blade or doctor, sharpened like a knife, thus leaving on the roll only the color in the recesses of the design cut out by the engravers. As the roll revolves still further across the cloth to be printed, the cloth picks up the color and the design is thus transferred to the cloth. It is really quite a simple operation, although my description of it may make it seem a bit complicated.

In closing, may I emphasize briefly the future trends in textiles as I see them:

1. In the way of raw materials, a definite shift from the natural products like wool, cotton, silk and linen to the synthetic fibers, rayon, celanese, lanitol, nylon, glass, etc.

2. In the manufacure of cloth, the possibility of radical changes into simplification from a mechanical standpoint.

3. In finishes, the increasing use of the new synthetic resins as finishing materials. These not only produce new

effects, but also improve the characteristics of the cloth by reducing shrinkage, fraying, slippage, etc.

4. In all textiles for dress fabrics, an increasing emphasis on style, the constant search for new trends and new designs.

In conclusion, I should like to present one final picture to you;—this one not on the screen, but in my own feeble words, I refer to a painting by an obscure Italian artist named Reni, but this one painting was his masterpiece. It depicts a corner of the heavens just before dawn. The lower half shows the earth in shadow, in the very background the dark, restive sea. In the upper half, heavy clouds are being rolled back like a curtain showing Phoebus, the glorious sun-God mounted in his chariot, his horses prancing, seven nymphs representing the daylight hours dancing around him already to start his daily circuit across the heavens. Over his head a cherub flies as the morning star and before them all steps his sister Aurora, rosy-tipped, in a shimmering robe of pale gold, pushing away the morning mists of pink and ivory to announce the dawn of a new day.

Ladies and gentlemen, it is my sincere belief that the textile industry of America stands on the threshold of a new day and you as consumers and we as manufacturers will enjoy and benefit from the textiles of tomorrow.

Soluble Chromium Derivatives of Dyestuffs

JAMES L. BOYLE

IT might be said, without much exaggeration, that the process of mordant dyeing is almost as old as the art of dyeing itself. The latest development, namely, the introduction of soluble metallic derivatives of mordant dyestuffs, has made it possible to obtain by a substantive dyeing process results which previously could be produced only by mordant dyeing. The present article will attempt to describe this development from the point of view of a chemist.

There are various methods whereby chromium can be applied as a mordanting metal:

Chrome Mordant Process. In this process the material is mordanted first, then dyed in a separate bath. Bichromate is used as the mordant but usually an "assistant" is also added, for if boiled alone with wool only a little dissociation of the salt takes place. The assistants fall into two classes depending on whether they give a reduced or an unreduced mordant. The former consists of organic substances—cream of tartar being the most satisfactory—which reduce bichromate to the chromic state and are used particularly with those dyes which would be destroyed by the oxidizing action of bichromate. The unreduced mordant is obtained by boiling bichromate with an acid, usually sulfuric acid, when the chromium is absorbed by the wool mostly in the form of chromic acid—though the reducing power of wool is sufficient to convert some of it to one of the hydrated forms of chromium oxide. It follows that such a mordant will be most satisfactory when used with a dye which develops its full shade only after oxidation, for it is the basic oxides of chromium that combine with dyestuffs.

After-Chrome Process. The class of dyes for which this method is most popular are the azo-mordant (mordant acid) dyes. This also is the group of dyestuffs with which this latest development is concerned.

They are applied to the unmordanted wool in the same way as the ordinary acid dyes and they must be taken up from an acid bath with good exhaustion; for one advantage of this process is that the bichromate can be added to the exhausted dye bath, thus reducing the amount of labor necessary. As a rule, it gives a faster dyeing than the chrome mordant process since there is less chance of any free dyestuff being left to wash or rub off—provided the dyebath was well exhausted. The range of the method is limited chiefly by the fact that the final shade is usually quite different from that of the original dye and since it does not develop till the mordanting process is complete, it is obviously difficult to match to shade. This disadvantage is least with dark colors and the process therefore finds one of its main uses in the application of the chrome blacks, such as Diamond Black P.V.

Metachrome Process. In the literature of dyeing, different authors have put forward different chemical explanations of this process. Briefly, the method consists in adding dyestuff and mordant to the bath simultaneously. The mordant used is sodium chromate and an ammonium salt. One explanation of the chemistry of the process is that, at the comparatively cold temperature at which the dyeing is started there is no dissociation of the ammonium salt and no formation of the color lake. Gradually however the acidity of the bath is increased, by the

ammonia being carried off with the steam, until conditions favorable to the precipitation of the color lake are reached. By this time the dye has been absorbed within the fiber so that formation of the color lake takes place there. The explanation of Horsfall and Lawrie (Dyeing of Textile Fibers) is that the dyestuffs applicable by this method can form chrome lakes, in the presence of the ammonium salt, which are simultaneously absorbed by the wool. They also suggest that the development of acidity is not due to the dissociation of the ammonium salt by heat but that a chemical reaction takes place presumably with the chrome lake, whereby ammonia is set free. Morgan (JSDC. 42, 56 (1926)) explains it as firstly a case of double decomposition by which ammonium chromate is formed and then dissociates slowly.

$$Na_2CrO_4 + (NH_4)_2SO_4 = Na_2SO_4 + (NH_4)_2CrO_4$$
$$2(NH_4)_2CrO_4 = 4NH_3 + H_2O + H_2Cr_2O_7$$

Thus there is a gradual production of chromic acid which is reduced by the wool to basic chromic hydroxide and this combines on the wool with the acid dye to form the lake "in situ." The number of dyes which can be applied in this way is very limited. Originally the process was restricted to certain dyes derived from picramic acid but it had such obvious practical advantages that empirical attempts were made to extend its range. There is now a mixed collection of dyestuffs which, due to one circumstance or another, can be applied in this way. This empirical application of the process may account for the divergence in the chemical explanations advanced.

There are various other one bath methods of mordant dyeing of less importance. The Chromosol mordant depends on the fact that concentrated solutions of bichromate and oxalic acid react together giving, probably, the double salt sodium chromi-oxalate and this compound can be used in a similar way to the Metachrome mordant, with some dyes. It is distinguished by having no oxidizing action. Another method is to treat the wool with bichromate and formic acid in the bath for 1½ hours at 160° F. and then to add the dye. The theory, in this instance, is that the formic acid drives the chromium on to the wool before the dye is added and thus prevents precipitation of the color lake in the bath. These one bath processes approach nearest to the method which is the subject of this article.

SURVEY OF THE PATENT LITERATURE

There are various processes for the production of metallic complexes of azo dyestuffs but in general they are prepared by heating the parent azo dye, in solution or suspension, in a medium which may be neutral, acid or alkaline according to the particular case, with a metallizing agent that reacts with the dyestuff under these conditions. The Badische Anilin & Soda Fabrik Company was the first to take out patents for the production of these compounds. Their method consisted in boiling the chromable azo dye with such salts as the fluoride, chloride, acetate or formate of chromium. They state that when salts of mineral acids are used an acid binding component, such as sodium acetate, should be added. This company however, visualized these complexes as being useful only for cotton printing and the manufacture of pigments and inks, whereas their present importance is due to their use as acid dyestuffs for wool and to a limited extent for other fibers. This development was due to the Society of Chemical Industry in Basle who took out the first patents for it in 1915.

At this early stage the complexes were prepared by obvious methods. The following for example, from B. P. 15064/15 is typical:—Chromium fluoride and the commercial dye from 4:2:1-ntiro-diazo-phenol and 1:8-aminonaphthol-3:6-disulfonic acid are boiled for one hour during which the solution changes in color from red to blackish blue. Anhydrous sodium acetate is added and the mixture boiled for a quarter of an hour, then filtered hot. Filtrate is evaporated, salt added, and left to crystallize for at least 12 hours. The green chrome compound which separates is filtered, washed with brine and dried. An interesting method is that of B. P. 15456/15 in which aqueous solutions or suspensions of o-amino-phenols, or —naphthols, are boiled with chromic oxide, or a salt of it, and the resulting chrome compounds diazotized by the usual methods. Thus the metallic compounds of o-hydroxy diazo bodies are prepared and if they are coupled to components which contain mordant groups the resulting dyestuffs do not contain the maximum proportion of metal. Such metallic derivatives are known as "half-chrome compounds."

The trivalent salts of chromium are preferred as metallizing agents but special cases have caused special chroming agents to be patented. A concentrated alkaline solution of chromium hydroxide i.e., a chromite, is often used. Chromic oxide, or any of the hydrated forms such as $Cr_2O_2(OH)_2$, especially when in colloidal form, is suitable in many instances or chromic chromate, $Cr_2O_3CrO_3$ which is prepared by the action of reducing agents —sodium thiosulfate or alcohol are specified—on bichrome. The above reagents form with dyestuffs, products similar to those obtained when trivalent chromium salts are used but they give higher yields in some cases than the chromic salts. There are however some metallizing agents that are preferred because of the peculiar products that result. Thus it is claimed that the complexes formed when basic chromic sulfate is used differ, in tinctorial properties, from those prepared with normal chromic sulfate; that when a chromable azo dye is boiled with the chromium salt of an organic acid, such as chromium benzene sulfonate, the metallic derivative obtained gives brighter dyeings than those prepared in any other way; and that a chromable azo dye can be made to combine with the chromium complex of the same or another azo dye, to give compounds which are described as intermediate products of the hitherto known chromium complexes.

In many of the patents it is recommended to add compounds other than the metallizing agent and the dyestuff, in order to obtain special results. In some of

these cases the mechanism by which this effect is produced is not at all obvious. B. P. 364147 and 384767 claim that "chromium complexes which are intermediate products of the hitherto known compounds can be prepared by treating dyes from 1-amino-2-naphthol-4-sulfonic acid or its nitrated derivative, and α- or β-naphthol, with a chroming agent in presence of a proportion of alkali metal ions which has not a salting out effect, until there has been formed a dye which is not precipitated by addition of a saturated solution of common salt." Such products are very soluble in water and give very level dyeings with good exhaustion. They differ from the normal complexes by giving a precipitate in dilute sulfuric acid solution and so cannot be applied to fibers in the usual way. Sodium formate or bisulfite are quoted as suitable sources of alkali metal ions, and the optimum proportion varies with the dyestuff used.

Organic substances such as glucose, starch or glycerine are often added especially when the preparation is in a strongly alkaline condition for they are said to protect the dye from the action of the alkali and to act as protective colloids preventing premature precipitation of the chromium hydroxide. The metallic derivatives of compounds with no solubilizing groups are often prepared in the presence of nitrogenous organic liquids, aniline and pyridine being the commonest but many of their analogues and triethanolamine have also been mentioned. The organic derivatives of ammonia seem to be the best organic solvents for metallic complexes.

Other interesting points gathered in a survey of the patent literature include the statement that by treating with a metallizing agent a mixture of different dyes containing mordant groups, there is formed a complex which contains the residues of several dyes linked to a central metal. This is similar to the product obtained by making a mordant color react with the metallic derivative of another mordant color.

Before closing this survey, the distinction between "primary and secondary chromium complexes" defined in B. P. 446,820, should be mentioned. The first patent dealing with metalliferous azo compounds specified that when the salts of mineral acids are used as metallizing agents, acid binding components such as sodium acetate must also be added. This remained an undisputed statement, at least with respect to chromium complexes, till 1931, when another patent claimed that mineral acid not only favored the reaction but that sometimes the reaction could be hastened by addition of mineral acid. The compounds so prepared, called secondary chrome complexes, differed from those previously obtained. The process was further explained in B. P. 446,820 where it was said that the formation of these new chrome compounds takes place in two phases:—

(1). Primary chrome complexes are formed by reactions in a neutral or very slightly acid medium and are identical with the products of processes in which neutralization of the liberated acid is effected.

(2). Under prolonged action of the chroming medium rendered strongly acid by the mineral acid derived from the chromium salt, and if desired by the previous addition of acid, the primary compounds are converted into secondary chrome complexes. The latter are characterized chiefly by their greater resistance to acids of all kinds and by giving brighter, more even and faster to light shades when dyed. The scope of the reaction is wide since all ortho-hydroxyazo dyes which can be converted into primary chrome compounds can be transformed into secondary ones by treating the former with mineral, organic or sulfo-aromatic acids in the absence of substantial amounts of chroming agents. The transformation takes place particularly well in the absence of neutral electrolytes—which shortens the time and permits a lower temperature of reaction.

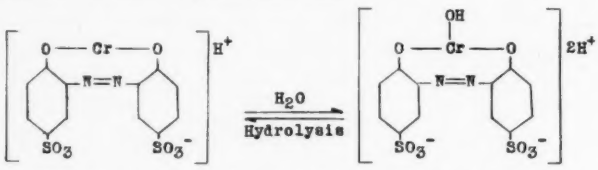
BEHAVIOR OF METALLIC COMPLEXES IN DYEING

In the use of these metallic derivatives as dyestuffs there are two stages. The material is boiled with the color and 4 per cent of sulfuric acid for half an hour, during which time the dyestuff penetrates within the fiber. But in order to develop fully the shade and fastness properties of these colors it is necessary to add another 4 per cent of acid and to boil for one and a half hours. No adequate explanation of the change which takes place on the fiber during this period of "development" has yet been evolved, though it is assumed that the soluble metallic dyestuffs are transformed into the insoluble color lakes presumably through a reaction with the wool substance.

Since this is a very important property of these compounds it is as well to consider some of the explanations that have been suggested; but before doing so it should be mentioned that there is an alternative method of development. This consists in replacing the second 4 per cent of acid by 1.5 per cent of sodium benzene sulfonate which is said to catalyze the development of these colors.

There are three general ways in which these dyestuffs might combine with wool. The sulfonic acid groups of the dye could react with the basic groups in the wool, the mordant metal not being implicated in any way; or there might be ionic combination between the mordant metal and the carboxyl groups in the wool. The third possibility is that the wool substance combines with the mordant metal by co-ordination. With such a complicated substance as wool it is not unlikely that all three methods are used to some extent. The similarity which these colors bear to ordinary acid dyes—insofar as their absorption by wool is concerned—points to the first method being used but their fastness properties indicate in a qualitative way that the metal is involved in the combination with the fiber. The subject has been investigated by Ender and Muller (Mell. Text. 1938) with reference to chromium compounds. They start by claiming that the free acids of these compounds are amphoteric, like wool, the chromium being present as a basic monovalent group. The complexes are represented as being similar to the

acid salt of a strong acid with a weak base and the complexion is easily hydrolyzed, thus:—



Their experiments then led them to the conclusion that salt formation takes place betwen the sulfonic acid groups and the basic groups in the wool and also that about 10 per cent of the basic groups in the wool are involved in a complex combination with the chromium in the dye acid. The "developing" action of mineral acid is attributed to a decrease in affinity between the wool and the dyestuff, which retards the combination between the chrome complex of the dye and the basic groups in the wool by increasing the ionization of the latter. The sodium benzene sulfonate is said to act in a similar capacity by attaching itself to the dye molecule so that there is less tendency for the wool-dye complex formation.

The above explanation implies that the change by the dyestuff from a soluble to an insoluble body is brought about by the wool substance replacing other molecules in the co-ordination sphere of the metal. In the light of the present knowledge this seems the most satisfactory explanation.

MODERN CHEMICAL THEORY OF MORDANT DYEING

Werner, in 1908, applied his theory of internal complexes to the problems of mordant dyestuffs and showed that the peculiar arrangements of groups on which mordanting properties depend are analogous to those which confer the ability to form co-ordination compounds.

The development of the electronic theory was responsible for confirming Werner's suggestions and for giving a more detailed explanation of the mechanism of co-ordination. For the purposes of this survey it is sufficient to consider that group of co-ordination compounds which are called "chelate." This term is used to describe those cyclic structures which arise from the combination of metals with organic (or inorganic) molecules that occupy two positions on the co-ordination sphere.

Chelate compounds may be either ionized or non-ionized. The metallic derivatives of mordant dyes are placed in the non-ionized section, the members of which are also known as inner complex compounds. The term "secondary valency" has been replaced by the electronic one "co-ordinate link" and explained by Sidgwick (Electronic Theory of Valency) as follows:—For a co-ordinate link to be formed atoms of different characters are required. The donor must have a "lone pair" of electrons and must be part of a stable molecule while the acceptor must have room for more electrons. In the case of the metallic derivatives of azo mordant dyes, the acceptor is the mordant metal. The donor (i.e., the atom in the dyestuff molecule which has a lone pair of electrons and is so placed that it can share them with the mordant metal forming a five or six membered ring) is usually taken to be one of the azo nitrogen atoms; it is maintained however that in some instances an ortho hydroxyl group changes to a quinonoid group and this latter then acts as the donor atom to the mordant metal.

The class of dyes which is most used for the production of soluble metallic derivatives is the ortho-substituted azo mordant dyes. The substituents which when present in the ortho position to the azo group give rise to mordant properties are mainly the hydroxyl, carboxyl and amino groups, though it is claimed that secondary amino and alkly—or aryl—oxy groups can take their place, and it will be seen that each of these groups could result in a univalent chelate molecule, one of the azo nitrogen atoms acting as donor.

Cheap Power and Heat

for Dyeing Plants

C. H. S. TUPHOLME

THOUGH central generation of power has advantages from several points of view, unfortunately many textile plants have shut down their own generating stations when the obtaining of current from the large power companies was not justified. Under this category fall especially those plants requiring, in addition to power, large quantities of steam in some form or other for processing or for heating. By suitably dimensioning the apparatus requiring heat, carefully studying the layout of the piping, making a judicious choice of boilers and engines, the service may be run in such a

(Continued on page 755)

PROCEEDINGS OF THE

American Association of Textile Chemists and Colorists

DECEMBER 25, 1939

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• CALENDAR • OF COMING EVENTS

Meeting, Philadelphia Section, Penn A. C., January 19, 1940.

Meeting, New York Section, Swiss Chalet, Rochelle Park, N. J., January 26, 1940.

Annual Meeting and Convention, auspices New York Section, October 18th and 19th, 1940, Hotel Commodore, New York City.

Organizing a

Dyeing and Finishing Plant

for Synthetic Piece Goods*

P. J. WOOD** F.A.I.C.

I CANNOT claim any great amount of originality for the subject of this talk but if it serves to impress upon everybody the value of adequate planning I think it will have accomplished its object. Of course, many people do a great deal of planning; you might call it fussing and when they get to the end of it they are no better off than they were in the beginning.

Planning must be adequate; it must be well thought out; it must be done effectively.

The first thing to do in approaching a matter of this sort is to put the problem down on paper. In other words, know your problem thoroughly, know how many pieces you are going to handle per shift or per twenty-four hours, how many days you are going to work a week and how many yards or pieces you want to process in that time. Then, of course, the thing you have to determine is what is the bottle-neck throughout the operation. I take it the bottle-neck is usually the dyehouse itself. You have to provide in the dyehouse sufficient footage or sufficient dyetubs if you want to carry out the processing successfully. That is a very hard thing to calculate on account of the variation in the shades the dyer is called upon to produce. Light shades, naturally, go a little more quickly than dark shades and direct shades much more quickly than the dyed and developed shades. One of the main troubles is in getting the powers that be to say what they expect of the dyehouse. Until you get some rough idea you are going to make a wild estimate and naturally you are going to estimate a little on the high side. I have no patience with those who say they can dye two rounds per shift because at certain seasons of the year we may get into dye and developed shades, whereas at other times we have mostly light colors and may be able to do two rounds plus per shift.

One must figure out the kind of machinery required for the particular kind of cloth and the number of machines that each kind of cloth will require. The next thing is to lay out a plan of a building to house these machines and make a scale drawing of that building. When that is done it is a very good plan to make small cut-out models of the machines, such as I have here, also drawn to scale. Those can be placed in position in the plan to work out the working space around them. I think that is one of the best ways to do it. This is a dyeing machine and this is a boil-off machine. You can lay those out on that plan and by so doing avoid a great deal of changing afterwards. It takes a great deal of money to move machines as large as some of the machines that we have in modern dyeing operations, particularly when you come to a Tenter-Palmer machine unit, which weighs several tons.

By laying out your models on a plan you can also, by measuring with a rule, determine what your clearances are around them and figure out what size trucks you are going to use and how to avoid congestion. In addition to that you can work out a routine which will give as little waste motion as possible in the handling of the goods. Before you put a brick on top of another brick you can actually plan your whole routine and figure just how much time it is going to take to do this work in that way.

These little models, I might call them, are moved about and moved about until the best possible arrangement is arrived at and the routine is figured to give the most economical handling with the minimum of trucking and also allowing enough room for storage purposes without interfering with the economical handling of the work. Then after drawing a final floor plan, such as we have here, with every machine in place, the next work is to lay out the steam piping, the water piping, the sewerage, and the electric conduits. In this way a great deal of needless changing of these items can be avoided, because if every machine is in place you can take the smallest possible amount of material and make an economical job in installing them.

I might say a word first about the construction of the dyehouse. The finishing room can be a room with a flat ceiling because there is not such a ventilating problem there as in the case of the dyehouse. For the dyehouse I prefer a monitor roof. There are several roofs designed for dyehouses but I think the best one is the monitor roof, which is a roof of this type, having a sort of lantern in the top with windows that swing open. You can put fans here in the side where the steam collects, and carry out the

*Presented at meeting, Piedmont Section, April 9, 1939.
**Royce Chemical Co., Carlton Hill, N. J.

steam. The construction may be anything you desire. In the south here you can make good use of wood. I like to have brick up to the window-sills and then you can have wood. If that wood is well painted you have very little loss of heat in the winter-time and good protection. The painting I like on the inside is fumeproof aluminum paint. There seems to be nothing that comes from that kind of surface which interferes with your colors, whereas with oil paint or water paint there is sometimes something objectionable.

The steam-line is best placed right along the center of this room and I think it is preferable to use welded pipe, because there is a great deal less danger from the drippings from the joints, which you have in the case of flanged pipe. With welded pipe you can draw from that to either side. The best method, however, is to take your feeder pipes all from the top, so that you get as little condensed water as possible. Then you can carry your pipe out on either side as convenient. The mains should be large enough to give the maximum amount of steam required for all parts of the dyehouse and for the boil-off, for the maximum amount required at one time. A very good plan is to have two inlets on each machine for the steam, because you will get less objectionable current and quicker action from the steam. You remember that I recommended that the steam pipes be up high in the room. For one thing, the pipe is very accessible and if you want to make an addition it is easy to bore a hole in there.

The same thing applies in the case of water-pipes. Two outlets to a tub are desirable. It is advisable to have two let-offs, one at each end, for the reason that it will save some productive time.

In order to get the best results the main water pipe should be large enough so that all the becks can be filled at the same time. It is very distressing to have to wait for a tub to fill up and so lose time.

As far as electric conduits are concerned, after having planned your machines in this way it is a very easy matter to put these in advantageously. There should be a few extra outlets. For instance, in a particular dyehouse I have in mind it was originally planned to sew all seams by hand and afterwards it was found advisable to sew them by machine in order to prevent the ends from creasing. So, having the main electric conduit here, it was an easy matter to drop down from here and have the sewing machines plugged in back of the machines and to sew the seams by machine. A few extra outlets are always an advantage.

So far as the sewers are concerned, the main outlet from the plant should be large enough to take the maximum load and it is well to take into consideration that all of the machines may have to be emptied at the same time. The outlets should be large enough to take care of them and should be so arranged that the floor will not be flooded. It is very dangerous to work on a flooded floor, and in pushing trucks through, a large amount of goods may be damaged. It is a good plan to have the sewer passing down directly under the dye machines with the two outlets dripping directly into the drain so that you have a dry floor at all times, or a practically dry floor. The only time you have a wet floor is when you are doing the flowing-over after operation, which I like to do because it takes care of a lot of scum and avoids a lot of spots. A concrete floor is the best floor. Have the slides sloping down to the drain, where the machine outlets are. Then the centre of the floor between the two rows of tubs is slightly crowned, so that the flow is always to the drain.

The drains are very often apt to become full of refuse, straw, string, thread, and sometimes rags. Sometimes people put a whole sheet down there. It is well to have some place where you can clean it out readily. That should not be under a dyetub and it should not be in a color shop. The best place is over a spot to be used as a runway, because there you can get it out quite easily. That is very easily taken care of and much better screened by having an angular screen. In other words your screen is a series of rods set this way. (Speaker illustrates by drawing on blackboard.) You have a larger space for the screening and another reason is that when you want to clean out the drain, if you have a vertical screen in there, it is very hard to draw this stuff up; it continually drops off your fork, whereas in this way you can drag it up an inclined grid to get it out very easily. These are all small points, but I think they are valuable things to consider.

To go back to construction for a minute, one problem in connection with the roof is condensation. In cold weather, with the ordinary type of roof, you have a certain amount of condensation because of the hot damp atmosphere inside and the cold air outside. That can be overcome by furnishing the roof with insulation, two and a half to three inches of cork insulation, which makes the roof quite a little more expensive, but at the same time it gives great relief from condensation on the inside of the dyehouse. You remember I told you the inside of the roof would be painted with fume-proof aluminum paint. At the same time, between the planks, it is well when constructing the roof to paint every place where there may be a crack because the minute moisture gets in there you are going to have rotting of the wood. For that reason it is well to use treated lumber, Wolmanized treated or creosoted or something of that sort, because you can prolong the life of the roof as much as fifty per cent or, as some people claim, one hundred per cent and the cost is not excessive in comparison with the benefits derived.

I do not like too many windows in the dyehouse because there are always drafts from them. Have as few windows as possible, depending upon the monitor windows to give most of the light. Have only a few windows around the sides. In that connection I should like to say that a window is a real hazard when you come to handle diazotized

colors. The nitroso body is very, very sensitive to the action of sunlight. In order to overcome that it is possible now to obtain what the maker calls actinic glass. I would rather call it non-actinic glass, because it does not let the actinic rays through. It has very little color; as a matter of fact you would hardly know, in entering a dyehouse glazed with this glass, that it is colored at all. This piece I have here, of course, against the white tablecloth looks rather dark. Looking at it against the light it has a faint amber color. In brilliant sunlight you can distinguish it, but in a dyehouse glazed with it it is very little different from ordinary sunlight. It has a rather pleasant appearance, in fact. It cuts out those dangerous rays of which we are all afraid. They not only affect the stability of the diazo body but also affect all colors. I remember a few years ago in dyeing acid magenta, which no one thinks of using today except as a fugitive tint, we had a great deal of difficulty in keeping it from fading while taking the goods from the dyehouse to the finishing room and, in fact, sometimes had to bring them back for re-dyeing. Ordinary glass lets through only eighty per cent of the ultra-violet rays; it does screen out some portion of them. This actinic glass allows only some twenty per cent to pass through. Those are the ones that give us most of the fading. After glazing a dyehouse with this glass we had absolutely no trouble with diazo developed colors coming up patchy or uneven.

With regard to ventilation, the recommendation of this particular type of roof for the dyehouse was of course made with the idea of getting the best ventilation possible, avoiding drafts and making the room comfortable, because, after all, temperature plays a role in the operation and efficiency of the dyehouse. Therefore stagger the windows on each side of the dyehouse with plenty of fans. I should say that the air in the dyehouse should be changed on an average of every four and one-half minutes. In colder climates it is necessary to have some sort of fog-elimination system. It is not so necessary here, but it is desirable to have some sort of small unit which can be operated when desired. It should be placed on the outside of the dyehouse so that when the temperature falls below a certain point you can blow in a certain amount of warm air. That can be directed around the room by a few ducts.

If the drying machine is placed near the dyehouse it is quite possible, with very little pipe connection, to carry warm air which still is not saturated into the dyehouse, and you get that practically free of charge. There is no good in turning it out into the open air.

There are just one or two other little points I shall mention. The color-shop, for instance, should be provided with good balances, a large one and a small one; and it is today, I think, more advisable than ever to adopt the decimal system. By that I do not mean to go to the kilogram and gram decimal system, although some people are using it now. Since weights are usually given us on goods as they come to us in pounds the best way is to have weights in tenths, hundredths, and thousandths of a pound. It is a very convenient system and if you once adopt it you will not depart from it.

In connection with the color-shop, there are some color-shops in which the boiling-up is done right in the color-shop. That is rather troublesome sometimes because some colors are rather hygroscopic and the steam will get over there and sometimes cake them, if it does no worse than that. So the boiling department should be separate and apart from the color-shop.

For boiling here is a little stunt that proved quite successful. A boiling pipe is very often a pipe screwed on to a steam connection. (Draws on blackboard). Here is a steam connection with a valve there. The man screws on the pipe here to the bucket, screws it off again, and lays it down. That has two disadvantages. First, it is troublesome and takes a lot of time; secondly, when he puts the pipe down at the side sometimes it falls down and has to be picked up again, or it might get lost and have to be replaced. Another method is to have a block under the pail and kick the block out when the pail is boiled. That is also objectionable. Sometimes you may jiggle the pail and spill some of the liquor which is expensive so we have a flexible metal hose and fixed on to the pipe, which is quite long, is a valve. That pipe is set in two wooden shelves, as we might call them, sticking out from the side wall, and they have holes in there through which this pipe passes. You can have a little neck of some sort on there or a hook which moves up and down. You can put your pail on the ground, put the pipe into it, do your boiling, and lift it up again. The pail can not very well fall off the ground. This method leaves the operator's hands free and he can take out the hose which is hanging there on the wall and wash it off before he leaves it. My orders are to wash it before using and after using it.

When we come to the question of the dyer's office the first thing to be considered is light. The dyer should have a comfortable office. The best thing is to have a corner room in the building and in each side have a five foot plate glass window—five feet square. That is quite expensive but I think it pays for itself, provided someone does not break them frequently, because I think the value of a window without cross bars is enormous. Shadows from cross bars will bother you no end.

There is another thing I might mention. Down here in North Carolina you have soil of a beautiful, rich red color. When that is exposed near the dyer's office he sometimes gets a reflection from the red clay. That is a charming color but it does not help the dyer. For that reason I like to protect him from anything extraneous. So outside his window I place a screen made of boards at an angle of forty-five degrees, tilted so that he gets

only light reflected from the sky and not light from the surrounding ground, either green or red.

For some reason I like to see the inside of the dyer's office painted a neutral tone of grey. We had a speaker here sometime ago who gave a talk on the different types of grey with which he had experimented. There is a certain neutral type of grey that gives no reflection in matching those colors we used to call tan drab, before we got a lot of fancy names for them.

I think this method of protecting the dyer's office is well worth anything that is spent on it. Have a boarding around there to keep everything but the light from the sky from the dyer's office.

In the office, of course, is needed a daylight lamp for night work. The better illumination you can get the better matching you can do. In addition to that you have to have working tools, a filing system, and so on. The filing system should be carefully thought out, so that everything is available on a moment's notice. A plan we found very good is to carry what we call a slip strip. In other words, whenever a man made a new color he would put every formula down on this strip. As he made his additions he would total the formula. That was found to be very helpful because occasionally you find that you want in-between shades. Occasionally you find them very, very useful. These should be kept together with a sample of the final color—all the reds together, the blues together, and so forth. The dyer can run through them and match his color, and we have found that very helpful.

The dyer should also have a cost keeping sheet which gives all the details you require—the dates, the shades, the ticket number, the number of yards, the customer, the quality, the prices, and the weight. This is a cost sheet (showing sample sheet) and here we have a list of materials used. The first copy, of course, is written up by the dyer for the color mixer, and a duplicate is sent to the color-shop. When you get through you simply extend those, put down the unit cost here, and the color cost. With very little additional work this becomes your cost sheet. It can be completed at the end of the day or on the following day, which is an advantage. You do not have it all piled up to do at some future time.

The tickets for carrying through lots should be in as convenient form as possible. This is a form (shows sample) that was found quite convenient, because after experimenting we determined that five or six pieces is about the limit we wanted to put on so we made this for six, as usually it is used for five. Five times five is twenty-five pieces, which is our top limit for this weight. Five of these would fit on a special truck which we had designed and made and which was uniform throughout the plant. In other words, only one type of truck was used. We use only one type of wheel, one type of truck, and one type of buffer, if you have a buffer on them. It has a tilting top, the middle pair of wheels a little higher than the others, and if you work out your type of unit you can work it out very satisfactorily. It can be turned around very easily on its center axis. When a man gets through with it he just puts his foot on it, gives it a slight push, and it goes on to the next man, so there is no trucking required.

Another thing to be considered is the laboratory. The laboratory-controlled dyehouse, if you have the right laboratory, is probably the ideal system. The laboratory can help the dyer a tremendous amount. As a matter of fact, the technician in the laboratory should be a dyer, should be a full-fledged textile chemist, in my opinion, with a good knowledge of dyeing. For instance, in the matter of making up a series of shades, when you have determined the sort of dyestuffs you are going to use your chemist can work profitably for a few weeks or a few months making combinations of shades. When he is through you can pick out combinations of shades. Here, (showing sample book), for instance, are the yellows and reds, yellows and blues, and yellows and greens. You can make just a little index of about what you can do with your colors in small combinations, which is a big help, because I have found that very often the dyer will use three or four colors to get some result that he should get with two single colors. For instance, he may use yellow and green, brown and red to get a dirty shade of green when he could use yellow and a dirty shade of blue, meaning a navy, to get that shade. So this is a big help to dyers, particularly apprentice dyers, because in many many cases they can match shades out of this book and in many cases estimate the between shades. In a series of three colors, of course, it is a little more difficult. So I think that is a very good function of your laboratory.

In the laboratory it is quite necessary to have a Scott or Suter tester to test the tensile strength of fabrics. Quite often the question comes up whether a piece of goods has suffered loss of tensile strength in dyeing.

Another important thing is to test goods which have been embossed in the greige to see if there has been any cutting there because a difference in the strength of grey goods and the embossed goods is a very good indication that cutting has taken place.

Routine tests for dyestuffs, as the previous speaker recommended, I heartily believe in. If we check them we are quite sure; we have verified them. It is a simple test to make if you have the same stainless steel tubs that we use. I should like to say something about stainless steel tubs. I have used copper-lined tubs; they were the best we had and we had to use them, particularly in silk dyeing. I think metal tubs are much better than wooden tubs, because sometimes in light colors when people complain about the shade of the goods it is due to the fact that wooden tubs have given up some of the previous color.

People used to dye silk in the old skein-dye tubs. All the old silk dyeing was skein-dyeing. In the old days

the National Silk Dyeing Company and the Weidmann Company had between them eight thousand men dyeing skein-silk. They dyed them in long narrow tubs. When they came to dyeing silk pieces, which was a new thing for them, they put them in those tubs and the goods, were drawn through the liquor by means of little hand reels provided with a handle. These things were so crude that they had wooden bearings. They were turned wooden gudgeons and turned in wood bearings. We used to put a little piece of soap in there so that they would not squeak. The silks we dyed sold for anywhere from one and a half to five dollars a yard. We had a lot of trouble with chafe marks. Everybody experimented with a lot of mechanical devices. The first was the old circular reel with a very deep tub. (Draws on blackboard). It had a little peg rail on the front. They took a pipe on a swivel and blew steam in to boil up the dye solution. Then a steam-pipe was developed in here, in a sort of little box. The trouble with that round reel was that it chafed the silk more. We tried all speeds and it would not do. For crepe de chine we could not use it at all; for habutais it might do. Then someone thought maybe if it were a little wider it would do. The trouble was with that that the goods lay here in a big pile and when it got bigger it would fall over to the front an get tangled up and eventually chafe anyway. I have seen goods so white that you would think they were covered with snow. The French call them "blanchisseurs." The next thing was to give a little traction, which was a big improvement. Some years later someone got the brilliant idea of using the elliptical reel, which is the form mostly used today. It is better than anything else. The goods are nicely folded at the back in using this reel and when you get them up to the top there is a good pull there and it is coming down you get first the reel in this position and then the reel in that position, with the result that you are getting the goods first from there and then from there. (Speaker illustrates by drawing on blackboard.) Also the goods can get out there. In the vertical back tub the goods would be trapped at the bottom of the tub and there would be a lot of tension. However, there was a good bit of tangling. A few years later we discovered the principle thing, which was finding the proper slope for the back of the tub and where to place it. Most of the machines are thirty to thirty-two inches high, and we found out how to arrive at that slope.

There was one other thing we had to learn and that was how to take the goods when they took this fold to keep them from dropping over the back. Sometimes you found the whole piece in the back on the floor. We found by moving this back four inches it would take care of that. So we have the machine as it is at the present time.

There is still a difference of opinion as to where the dyeing is done. Some say it is done here. (Pointing to sketch on blackboard). I think you do some dyeing there but not leveling. In my opinion the leveling is done here. I thought it might be of interest to show the evolution of that particular type of machine.

I have purposely not talked about the production of goods because I thought if you could stand me again I might come sometime and talk on that subject. (Applause)

DISCUSSION

A Member: There is one question I want to ask. That is how you get out three loads on an eight hour shift.

Mr. Wood: You know I qualified that. I said some people claim to dye three loads to a shift. I am talking about formula dyeing, not spoon dyeing. It all depends upon having the goods ready to go the minute you get in and not waiting for the boil-off or anything like that. You put the goods in. I do not know how long it takes to load, but I do know I had a boy that could load twenty-five pieces in eighteen minutes and sew them all by hand. But I allow them half an hour to fill up a machine of that sort. It takes you half an hour to come up to temperature. (I am talking about light shades.) Then there is another half hour for your addition of salt. There you have an hour and a half. All right; if your shade is right you are done, aren't you? But you have to wash and unload.

Same Member: What kind of cloth?

Mr. Wood: I am talking about rayon crepe.

Same Member: All rayon?

Mr. Wood: All rayon, yes. That is the quickest cloth because you do not have to match fibers. I am talking about the quickest load. I said I would not figure three loads per shift. I figure a minimum of one load per shift for diazotized and developed colors. There you have one and one-half hours for loading, coming up to temperature, and adding salt and another half hour for unloading. That is two hours. Allow another half hour. That allows three loads per shift—seven and a half hours and leaves you a half hour to spare. That is on light colors, light pink and blue. I would not promise to do that. I would say if you are doing two light shades on a shift you are doing pretty well. I would say, if you can do two light shades on a shift, three dark in two shifts and two diazotized in two shifts I think that is about all you can figure on. When I say three to a shift you know that is like running a hundred yards in record time.

Chairman Gaede: If you will pardon me, I think your exact words were that you had heard of people who had done three lots.

Mr. Wood: Yes. I was inclined not to believe them when they said they had done two lots of dark shades in a shift.

Mr. William Transou: What do you think is a fair percentage of seconds?

Mr. Wood: I went into one plant and they told me that they figured on six per cent as being a fair amount.

I have seen regular running at three and one-half per cent, which I think is very good; and I have seen a spell where it was a good deal lower than that but I think that was helped by a lot of circumstances too numerous to mention. It is very, very exceptional, I think, if you get three per cent or lower and if you do I think you are getting a very good job.

A Member: It depends a lot upon the cloth you are running, does it not?

Mr. Wood: Oh, yes, indeed. It depends a lot upon the sizing, too. I have seen many times when from two different mills you have exactly the same kind of cloth and one would take twice as long as the other and often you have to redye one for the reason that there is something lingering in there that should have been removed. I think pretreatment of the cloth has much to do with it. I think you can handle your dyeing by determining the best way to handle the goods in your laboratory and save a lot of time in consequent reduction of running time.

Mr. Souther: I should like to ask Mr. Wood how to determine the slope on the side of those reels.

Mr. Wood: Maybe my drawing is not very good today. I will draw it all over again. Here is the reel in vertical position— an elliptical reel. When the reel is in that position if you draw a plumb line directly down from it you get a certain point here. We will say this is the bottom of the tub. Here is the top of the tub. You want to know where to make that slope. There is your line drawn from the reel in the vertical position. When the reel is in the horizontal position it will appear like that. Then drop a line from the end of the reel directly, like that. That hits the top of the tub at that point. That is your slope, from there to there. Then move it four inches back. I say four inches, but that is arbitrary. I told you why we like that slope. It must be the slope that eases the goods down so they just gently fall down there. If you have that straighter the tendency is for them to fall over here and they fall on the goods that are coming out and you have an awful jumble there. On the other hand, if you have a slope like this (illustrating) the goods just park on there; they will not slip. With this slope, however, it is just easing them off all the way. The object is to get them as loose as possible at the bottom so you get that unfurling action. From there to there is where your leveling is done.

Mr. W. B. Sellers: If you use a stainless steel reel do you get as much pull as you do with a wooden reel?

Mr. Wood: It depends upon the type of reel. Many different kinds have been tried. We have had all kinds of reels. That was another piece of experimental work that took a lot of patience. You know in the beginning these reels were made of wood slats which had a lot of traction of their own. They were disposed around the periphery like that (draws sketch). The first reel made of stainless steel followed the old system. That was so slippery it was practically the same as a solid reel. Some people used solid reels but I never liked them. The first ones, of course, were made in imitation of the wooden reel, but they were not satisfactory, because they did not have sufficient traction. The first one similar to this was made by a company in Paterson. There is the old type of reel (displaying photograph), and here is the new (speaker displays another photograph). There is still another type which I developed myself which I do not think is as good as that one, to be perfectly frank, but it does the work. The theory I worked on is this. When we found there was such a slippage in the old type with these slats then we cut out all the slats but three there, three at each end, and left nothing in between. So when the goods came in here they were not sliding across but came along with a little more traction. The goods would fall in between the groups of slats a little. It sort of clung a little bit. The one I developed is like the half of an octagon, where you get this drooping in between.

ONE HUNDRED AND TWENTY-FIFTH COUNCIL MEETING

THE Council held its 125th meeting at the Chemists' Club in New York on Friday morning, Nov. 17, 1939. Present were President Alban Eavenson, presiding; Arthur R. Thompson, Jr., Vice-President; William R. Moorhouse, Treasurer; Louis A. Olney, Chairman of the Research Committee; William H. Cady and Robert E. Rose, Past Presidents; Kenneth H. Barnard and Walter M. Scott representing Northern New England; George L. Baxter, Henry F. Herrmann and Harold W. Stiegler representing New York; Charles A. Seibert and Herbert S. Travis representing Philadelphia; and Harold C. Chapin, Secretary. The Secretary's report of the 124th Council meeting and balance sheet of Nov. 10, and the Treasurer's report of Nov. 14, were accepted.

A report was accepted from the Tellers, C. L. Daley, E. E. Fickett and the Secretary, declaring election of Carl Z. Draves, President, and re-election of Duncan Ferguson and Arthur R. Thompson, Jr., Vice-Presidents, for the year 1940.

It was voted that the bonds of Treasurer and Secretary be held by the President currently in office. To facilitate accounting and auditing it was proposed that the fiscal year of the Association be changed to the year beginning August 1, without change in the date of Nov. 1 for payment of dues. This was approved in principle, and to recommend enabling changes in the By-Laws a committee was appointed, consisting of Charles A. Seibert, Chairman, William H. Cady, the Treasurer, and the Secretary.

It was voted that $5,000 be transferred from the General Fund to the Research Fund; that $900 from the Research Fund be appropriated for continuation of the Research on Textile Finishes at the Massachusetts Institute of Technology; and that $6,800 for salaries and general expenses,

SECRETARY'S BALANCE SHEET—NOV. 10, 1939

	Applications	*Dues, Regular and Reinstate.*	*Dues, Corp. and Sustain.*	*Miscellaneous*	*Bank Charges*	*Totals*
Received by Secretary, Nov. 1, 1938, to Sept. 7, 1939	$1,202.50	$10,200.36	$2,755.00	$1,680.54	—$4.74	$15,833.66
Received by Secretary, Sept. 7 to Oct. 31, 1939..	262.35	2,968.00	130.00	706.41*	....	4,066.76
Total for fiscal year ending Oct. 31, 1939.....	1,464.85	13,168.36	2,885.00	2,386.95	— 4.74	19,900.42
				—4.74 bank charges		
				2,382.21		
Transmitted to Treasurer.....	1,464.85	12,777.69	2,825.00	2,382.21		19,449.75
Carried forward, Nov. 1, 1939.....	.....	390.67	60.00	.....		450.67
Receipts, Nov. 1 to Nov. 10, 1939.....	132.50	1,926.50	1,845.00	3.80†	— 1.00	3,906.80
Total for fiscal year beginning Nov. 1, 1939....	132.50	2,317.17	1,905.00	3.80	— 1.00	4,357.47
Transmitted to Treasurer.....	132.50	2,003.67	1,895.00	3.80	...	4,034.97
Leaving to order of Secretary.....	.....	313.50	10.00	.....	— 1.00	322.50

and $500 for equipment, be appropriated from the Research Fund, to be expended under direction of the Research Committee Chairman, for purposes outlined by the Committee on Coordination and Publicity, and for Research, at the Lowell Textile Institute.

Each of the following was elected to the class of membership specified, as of thirty days from publication of application, provided no objection be received meanwhile by the Secretary:

Senior

J. T. Allen	J. Harrell	J. E. McNeely
J. Anderson	J. R. Harrington	L. O. Meyer
F. W. Benvie	E. G. Hibarger	G. C. Page
H. W. Birch	W. Holpfner	M. A. Perkins
E. I. Birnbaum	W. D. Humphreys	R. W. Powell
A. J. Bruno	H. L. Jones	G. L. Royer
C. R. Cayen	J. H. Jones	A. E. Slater
G. A. Cooper	V. F. Kavanagh	F. T. Snowling
G. J. Curry	W. W. Lane	G. B. Stackpole
J. Dammicci	J. S. Lee	H. D. Tucker
F. C. Dixon	S. C. Linzey	H. J. Waldron
C. E. Fickinger	A. R. Lundquist	H. F. Weidman
R. G. Fiddes	W. A. Manss	F. L. Wilhelm
R. Firth	T. M. Marshall	J. T. West
S. Goldstein	W. E. Marston	H. P. Whitenight
	L. Mayfield	

Junior

D. M. Achey	D. Fogel	B. J. Tyler
B. R. Celentano	W. S. George	W. D. Worth
C. P. Flanagan	W. T. Grandy	R. M. Zelen
	R. H. Sullivan	

Associate

F. Aufrichtig	H. J. Horne	H. M. Olson
W. S. Chapin	W. A. Hyde	D. M. Russell
W. Dobbs	J. J. Kilroy, Jr.	A. E. C. Smith

Student

E. J. Epstein	R. G. Hochschild	I. P. Mintz
S. Finard	C. F. Horn	S. J. Puliafico
H. L. Golson	T. H. McCamy	S. I. Saltsman
A. H. Grondin	C. M. Rich	G. R. Turner
C. B. Hayes, Jr.		G. S. Urlaub

Miscellaneous Items

Registrations, Annual Meeting	$596.00
Year Books	35.05
Dyestuff Reporters	17.55
Crock Meters	25.10
Crock cloth	4.40
Knitted tubing	18.31
Dyed standards	6.00
Buttons	3.00
Analytical Methods	1.00
	$706.41*
Year Books	$1.50
Crock cloth	1.30
Dyed standards	1.00
	$3.80†

The following were transferred from other classifications to Senior membership—L. G. Atkins, J. A. Camelford, R. Z. Farkas, Ira Sapers.

Respectfully submitted,

H. C. CHAPIN, *Secretary.*

MEETING, PHILADELPHIA SECTION

THE last meeting of the Philadelphia Section was held at the Penn Athletic Club Friday evening, December 8, 1939. We had as our speaker Mr. Ephraim Freedman of R. H. Macy & Company, New York City, whose subject was "The Consumer Marches On."

Mr. Freedman answered many questions on the above topic, which followed his talk

Respectfully submitted,

J. P. CONAWAY, *Secretary.*

• OPEN FORUM •

Rules under which this department of the REPORTER is conducted are as follows:

1. Anyone who has a technical problem on which he would like advice may submit it to the Reporter and it will be published in the first available issue.

2. Any reader who feels that he has a solution of the problem may forward his reply to us and if we feel that the reply is suitable it will be published in a succeeding issue.

3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

47—In recent months we have experienced an entirely new trouble, the very uneven package dyeing of several lots of mercerized yarns, both high grade Combed Peeler and Sak, and both warp and skein mercerized. Satisfactory formulas and methods in the same dyeing machines on the same day act entirely differently on different lots of yarn, therefore methods or water or machines or dyestuffs are not responsible. The dyeing is uneven and the shade is entirely off. On the worst yarn lots there is an actual precipitate from the dyestuff on the outside of the packages. The dyeing is direct, also developed. The worst yarn is also troublesome in skein Vat Dyeing, not in unevenness but in consuming 20 per cent too much dyestuff. The yarn which dyes unevenly with direct dyes in packages can be dyed nearly evenly in skeins with special care. The package dyeing is done in the original wetting out bath and no betterment when the yarn is separately boiled out with scouring or soluble oil. None of the troublesome yarn shows an alkaline reaction from imperfect souring but in some cases a slight souring before dyeing has helped and in other cases no. We notice the most troublesome yarn takes many times as long to wet out in the standard laboratory wetting out test as the satisfactory yarn but in the uneven dyeing we are sure the yarn was properly wet out. In other words the troublesome yarn seems to be to a certain extent waterproofed and to have a precipitating effect on dyestuffs. There are certain chemicals used on Cotton, which are permanently absorbed by cotton and which produce results identical with the above, but the spinners say they use no chemicals whatever and the mercerizers use only caustic and proper souring procedure. What do you say is wrong with the troublesome lots of mercerized yarns and can you suggest remedies? **G.L.**

Answers

Answer No. 1—The inquirer failed to mention anything about the source and quality of his water supply, what machines he uses except to say package and skein dyeing; what direct dyes or developed colors he uses and how he does it, so we shall follow the elimination process to get at the bottom and find the reason for his off colors and uneven dyeing.

The Proper Dyeing Method

The right procedure in dyeing mercerized cotton, in skeins or any form, is to thoroughly wet the yarn in the dyeing bath, then to enter the properly dissolved dyestuffs strained from a sieve, and boil for 15 to 20 minutes. At this time the needed amount of salt or Glauber's salt is added and boiling continued for 30 minutes longer. The proper amount of salt is determined by the quantity of dyestuff in the bath, and is from 5 to 30 per cent of Glauber's salt for the darker shades. Of common salt only half that amount is needed. When troublesome yarn is encountered it is advisable to use some mild alkali in the wetting bath. Silicate of soda and phosphate of soda are excellent aids for this purpose. Boiling about 10 minutes before adding the dyestuffs will correct many variables in the mercerized yarn and an even dyeing assured. When boiling the dyestuffs in the yarn without any salt a thorough dispersion of the dyes takes place and when the bath is salted the danger of uneven dyeing greatly eliminated.

How is the Water Supply?

If this is the method used by the inquirer and the results are not as expected then the trouble is somewhere else, so we shall now look into the water. However, it must be mentioned that with the above method, and using a little alkali in the bath, good results are possible even with unfiltered or hard water. But sometimes even when the dyehouse is provided with the best filtering and purifying system the water is not of the best unless proper care is taken of the apparatus. Many instances can be told of costly damages caused by careless filtration of water, into which we shall not go at this time. Suffice it to say that if the inquirer is very sure that his water supply is constantly of the best we will look into something else.

Properly Prepared Yarn

The inquirer said that yarn, which dyed unevenly with direct dyes in the package machine, could be dyed nearly evenly when worked in skeins with proper care. Whether his skein work is done by hand or in a skein dyeing machine is immaterial. The fact is that in skein dyeing the bath is necessarily more voluminous than in a package machine; the yarn is loosely circulated in the dyeing liquor and all threads have a chance to be treated alike. In package dyeing, on the other hand, the yarn is wound on cones one layer over the other and the dyeing liquor is drawn

in and out of the coned yarn by pressure. Here then there is more than one element of chance: If the cones are not wound with equal tension the yarn may not take the dye evenly; the perforation in the pipes may get obstructed, impairing or preventing free circulation; the pump pressing the liquor in and out of the yarn may not function properly. Since modern machines are not all 100 per cent perfect, as the late Thomas Edison asserted, an inspection of all the parts involved in the package dyeing machine may reveal something towards solving the problem.

Suitable Dyestuffs

Because this dyer said that "satisfactory formulas and methods in the same machine and the same day worked entirely differently on different lots of yarn" the question of suitable dyestuffs should not be disregarded. Presumably those lots had been badly mercerized. However, before dismissing the argument it should not be amiss to ask if the badly dyed lots were dyed the same as shades which came out satisfactorily. There are dyestuffs which give satisfaction when dyeing in skeins and in a loose bath, but may not be suitable for package dyeing. This may or may not be the cause of his trouble, but it is worth considering in this elimination process.

It is also possible the operator has rushed the dyeing and entered the chemicals at the wrong time, as the writer had the misfortune of learning on different occasions during his career, but of course the remedy for this is obvious.

Assuming there is nothing wrong with the mercerization, checking up on the above, the suggestions of the writer are:

1. To boil the coned yarn for about a half hour in the package machine with a small percentage of a mild alkali before entering any dyestuff. This is not only for the purpose of wetting the cotton, but also to equalize the acidity or alkalinity of the yarn.
2. Add no salt to the dyeing bath before at least 15 minutes to allow the dyestuffs to properly circulate and be dispersed throughout the yarn. It is also better to add the salt to the bath in two or more small portions.
3. Be reasonably sure the yarn for the package machine is wound on cones with uniform tension, not too loose, but especially not too tight as to interfere with the circulation, which is mostly the cause for uneven dyeing in a package machine.
4. Take care that the water supply is constantly of good quality. It may change suddenly, especially on busy days when much of it is used, even with a perfect filtering system, if not watched.
5. Check up on the line of dyestuffs suitable for package dyeing. With the proper dyestuffs there is no danger of their breaking down and precipitating outside the packages, which happens especially when suggestion number one is disregarded. There are few causes for the breaking down of dyestuffs: when too much of it is in the dyebath; too much salt or acid in the bath; an improper combination of dyestuffs. These are the most common and are easily checked.

The writer sincerely hopes this inquirer may find the solution of his troubles from the above suggestions, or he may jump on the mercerizer with the conclusive proof that he is to blame for the uneven dyeing.—**Noel D. White.**

Answer No. 2—The difficulties in dyeing the mercerized yarns are due, in all probability, to the precipitation of natural cotton waxes and pectin matter on the yarn from the caustic mercerizing baths.

During the mercerizing, a part of the natural cotton impurities are removed by the caustic bath and carried in suspension in the bath. After the caustic has been used over and over for fresh skeins, the bath becomes saturated with the impurities, and they are reprecipitated on the yarn. This causes the uneven dyeing.

The solution of the problem is for the mercerizer to replace his caustic with a fresh solution before it gets saturated with the impurities. This may be determined in advance by analytical methods. The dyer may correct most of the trouble by giving the streaky yarn a boil of 3 degree twaddle caustic with a suitable penetrant. Soluble oils, etc., are not drastic enough in their action to actually remove the waxes and pectin matters.

The waxes in the yarn from the caustic bath are responsible for the poor wetting-out in the standard laboratory test.

The 1937 cotton crop appeared to have a higher percentage of waxes and pectin matters than is usual. This was due to insufficient rains, lack of fertilizer in many fields and partial erosion on others; all contributing to higher amounts of unripe fibers, more impurities, and consequently more trouble for the mercerizer. The 1938 crop is definitely better along these lines than the 1937 crop.

Different penetrating agents are being used by the mercerizers in their caustic baths. While a certain one may give better penetration, it may also have the tendency of removing more of the yarn impurities than the next penetrant. Consequently the bath may be expected to reach saturation sooner with a penetrant of the first type.

—**P. E.**

Submit your

PROBLEM

to the

OPEN FORUM

Cheap Power and Heat

(Continued from page 744)

way that power can be generated under extremely favorable conditions; it may, so to speak, be obtained from waste energy. In order to avoid large capital investment, it may indeed be more convenient to obtain power from the electricity works, instead of installing the plant required for utilizing rationally the drop in heating steam pressure; but this neglects the fact that certain economical factors are adversely affected by this method of operation and manufacturing profits are appreciably reduced. It not seldom happens that this method of working results in losses or reduction of profit, amounting possibly to as much as 3 per cent of the annual dividend. It can be shown by simple calculation that in dyeing plants requiring both heating steam and power, the power can be generated at a cost which is at the most 1-5th to 1-3 of the price paid for current from a power company. In addition to that, an independent power station offers the great advantage of making the service independent of weather. It often happens, particularly in summer, that overland transmission lines break down in consequence of thunderstorms, depriving whole districts temporarily of electric supply, an event which may hit the consumer all the harder since it happens suddenly without any previous warning. Such disturbances may cause great losses, not only because of the interruption of work, with consequent loss of time, but also because of the changes occurring in half-finished goods.

It is therefore easy to understand why there has been a strong movement in recent years towards rationalizing works using heating steam and power and extending them, thus endeavoring as far as possible to make up for what has previously been neglected. Not only manufacturers and managers, but also political economists, devote attention to this problem, since it is a question of utilizing national resources and awaking slumbering forces which in their totality are of great importance for the country in question.

In one dyeing plant, for example, a primary steam engine was recently put into service which is worthy of mention for several reasons. Even if it does not work absolutely with super high-pressure steam, it is still, with a boiler pressure of 500 lb. per sq. in., well within the range of high-pressure plants. Compared with previous steam-engine practice, the speed at which the engine runs is also high, being 250 revs. per min. for an output of about 1,000 B.H.P. In steam engines of this size, it was necessary until lately to keep to speeds not exceeding about 150 revs. per min., since most steam-engine designers would not consent to higher speeds being adopted. Builders of Diesel engines, however, have long prepared the way for higher speeds.

Before the latest extension, the power plant in this dyeing works consisted of a 400-kw. hydraulic turbine, while a large quantity of electric energy had always to be purchased from electric power companies. The steam engines worked with steam at a pressure of 115 lb. per sq. in. gauge and a temperature of 480° F.; the back pressure varied from 10 to 15 lb. per sq. in. In time this old plant became incapable of supplying all the power required, and after a thorough study of the circumstances the proprietors decided to extend it by installing a primary high-pressure steam engine. The high-pressure boiler supplies steam at a pressure of 500 lb. per sq. in. and a temperature of 700-750° F. The steam engine has two cylinders driving a common shaft carrying a three-phase generator; in one cylinder the back pressure is 140 lb. per sq. in., in the other 28 lb. goes to the heating apparatus. Normally the primary steam engine develops about 720 kw., supplying 4 to 5 tons of steam per hour at a pressure of 140 lb. and a similar quantity at 28 lb. per sq. in. In addition to that, a heat accumulator is fitted in the system receiving steam at 140 lb.; it consists at present of one vessel with pump and regulating members, to which a similar vessel will later be added. It works as follows:—

When the demand for steam at 140 lb. diminishes, the surerfluous steam is automatically led into the heat accumulator, where it condenses, thus raising the temperature of the water contained in the vessel. From the top of the accumulators where the temperature is highest, feed water is withdrawn for the boilers. The capacity of the accumulator is such that it can take the whole output of the boiler for 30 minutes. This arrangement not only makes it possible to balance the power and heating steam consumption within wide limits, but also allows the boilers to remain always fairly uniformly loaded, so that they work with the highest possible efficiency.

An example of a plant in a chemical works is the one built for the manufacturers of starch and dextrin. In manufacturing starch a large quantity of heating steam is required for the drying machines, as well as the moistening and drying chambers, while electric power is at the time required for driving various machines. Investigations and calculations based on statistics showed how the cost of heat and power compared on the one hand when using low pressure boilers for raising heating steam and purchasing electric current from a supply company, and on the other hand when installing a process steam and

power plant with boilers working at a pressure of 215 lb. per sq. in.

When working 2,700 hours annually with an average load of 200 kw., and allowing 15 per cent for interest and depreciation on the capital invested in the plant, the annual saving effected by reducing the cost of current was about Sw.Frs.* 20,000—during the depreciation period, or about Sw.Frs. 30,000—after the cost of the plan had been completely written off. Based on this result, the erection of the combined process steam and power plant was decided on. The plant consists of two single-bank upright water-tube boilers with a total heating surface of 3,250 sq. ft. and working at a pressure of 215 lb. per sq. in., with superheaters, economizers, underfeed stokers and a back-pressure steam engine rated at 250 B.H.P., working with superheated steam at 200 lb. per sq. in. and 570° F., with a back pressure of 30 lb.

The steam engine, which drives a flywheel generator mounted on the shaft, runs at 250 revs. per min. It is controlled by a speed governor working in conjunction with an oil-operated steam-pressure regulator, which maintains the steam pressure in the heating mains constant at 30 lb. per sq. in., so that if the exhaust steam from the engine is not sufficient to cover the demand for heating steam the difference is made up by supplying live steam through a pressure-reducing valve.

The plant is therefore capable of covering all the power requirements of the works and also for supplying the necessary heating steam at a pressure which is kept absolutely constant. Since the demand for power and heating steam coincide very closely, practically all the steam passing through the engine can be further utilized, thus effecting the above-mentioned, not inconsiderable annual savings.

The steam engine in this plant does not work, strictly speaking, in connection with the heating services, since it is under the influence of a speed governor and is worked according to the demand for power and not according to the demand for heating steam. A steam engine working solely according to the demand for heating steam has no actual speed governor, but is only controlled by the steam pressure regulator in such a way that all the steam required for manufacturing purposes or heating is passed through the engine, which converts into mechanical energy as much of the available heating energy as possible. When an engine works in this manner, it is necessary to have a second source of power, either a second engine, a steam or Diesel engine, or to purchase electric energy from an outside source. The back-pressure steam engine is coupled to the second source of power, preferably electrically, and thereby kept in step. A speed governor is as a matter of fact generally provided, but it is set for a somewhat too high speed, and consequently serves only as a safety governor, coming into action if the engine should for any reason fall out of step.

*The Swiss franc is currently quoted at approximately 22½c.

Another method of carrying out the same principle consists in the steam-pressure regulator not adjusting the valve gear of the steam engine directly, but with the assistance of an electric remote speed-adjusting device on the speed governor, the speed of the engine being adjusted according to the demand for exhaust steam in such a way that output and the quantity of steam correspond to each other.

The new steam power station of another dyeing plant at Strasburg, comprises two back-pressure steam engines, one of which is regulated in accordance with the back pressure by means of an automatically working remote speed adjustment as mentioned above. This engine develops normally 210 B.H.P. at 250 revs. per min., working with steam at an initial pressure of 170 lb. per sq. in. and a back pressure of 35 lb. The second engine in the same power station has an ordinary speed governor; it develops normally 400 B.H.P. at 214 revs. per min. with steam at the same initial pressure and a back pressure of 15 lb. The steam pressure of 15 lb. per sq. in. is kept constant by a steam-pressure regulator which operates a make-up valve allowing steam to pass from the system at 35 lb. pressure to the system at 15 lb. pressure when required. These engines work in parallel with the town supply and also with a hydraulic turbine plant.

A reciprocator is capable of converting the maximum possible quantity of heat energy into mechanical energy from the quantity of heating steam available with a given drop in pressure. This output is as a rule about 30 per cent greater than that of the steam turbine working under the same conditions. The reason of this is that, when working with back pressure and comparatively small loads, the steam turbine utilizes the pressure drop less efficiently than the reciprocator in consequence of the unavoidable clearance losses. An additional advantage of the reciprocator is that the steam consumption per B.H.P. hour varies little, even with greatly fluctuating load; as is well known this is not the case with the turbine. The somewhat higher first cost of the reciprocator is consequently soon paid off by the greater output and the extra profit thereby realized.

The exhaust from the reciprocator is certainly contaminated with oil, which must in many cases be removed before passing the steam into the heating mains. For this there are a number of separators available, which clean the steam until there is only a trace of oil left, at the most about 1/10th of an ounce per ton. This proportion is so small that it is no drawback in most processes. However, where absolutely pure steam is essential, i.e., when the least trace of oil might have a bad effect (such cases are very rare) purification can be carried still further and guarantees given that the exhaust steam from the reciprocator will be quite as pure as that from a turbine.

This effect may be obtained, for example, by adding a chemical purifier. The steam containing oil is led through nozzles into a large tank at the bottom of the apparatus, the tank being about two-thirds filled with water; the

purified steam issues at the top. In passing through the water, the last traces of oil are chemically combined with aluminum hydroxide and precipitated to the bottom of the tank as a sediment, which has to be removed from time to time. This is an extremely simple and also inexpensive apparatus, for which as a rule the shell of an old Cornish or Lancashire boiler may be used. The method of working is also very simple, and the cost of the chemicals (aluminum sulfate and caustic soda), which have to be added at intervals of three to four weeks, is insignificant.

In spite of the above-mentioned advantages of the reciprocator, it cannot compete with the back-pressure turbine, which is cheaper to acquire and delivers steam free from oil, in cases where the demand for exhaust steam is out of all proportion to the mechanical energy required. In such plants the fact that the turbine develops less than a reciprocator is of no importance; the turbine is the simplest and cheapest machine to adopt here, and is also quite reliable.

For such conditions the back-pressure turbine can be recommended; it allows the steam to expand down to the necessary heating pressure, as a rule in one pressure stage, rarely in two or three stages, thereby obtaining the mechanical energy required in the works. The cost of generating electric energy per kw. hour is not less favorable than with the reciprocator, since in considering the total thermal efficiency of the service, the efficiency of the heat engine plays a very small part, since the heat energy which is not converted into mechanical energy, remains available in the heating steam. The annual saving made by generating cheap current with a turbine is certainly correspondingly less when small quantities of current are required; but on the other hand the cost of acquiring the plant is also less, and in the most cases a turbine of this description will pay for itself in two or three years from the savings made in the bill of electric energy. For a back-pressure turbine with electric generator it is always possible to find a suitable site without having to make any great structural changes to the buildings, since the plant takes up very little room and can be adapted to suit existing equipment.

When such an inexpensive machine, simple and reliable in service, is on the market, there can be no excuse for the practice adopted by many firms of taking heating-steam from the boiler through reducing valves, unless, of course, they have no use for the mechanical or electric energy which may be generated. The back-pressure turbine may be compared to a pressure reducing valve doing work.

Where new boilers are to be installed or existing plants brought up to date, the question of the proper pressure to use in order to cover the demand for electric energy as far as possible from the fall of pressure in the heating steam, should always be thoroughly studied. There is absolutely no doubt that the adoption of this method leads to increased efficiency and increased profits.

Spot Testing

in Textile Analysis

ERWIN J. SAXL*

SPOT testing as a reliable tool for the simple and fast determination of small amounts of impurities present, has been a valuable aid for the determination of inorganic ions as well as of organic compounds. Economy of time, minute amounts of the material to be investigated, small laboratory space and low initial and running expense of an outfit to carry on spot tests, make spot tests in the words of their founder, "the qualitative analysis of the future."[1]

This paper does not attempt to discuss the details of this fascinating method of chemical analysis, beyond calling the attention of the textile chemist to a versatile tool heretofore practically never used in textile research, to any large extent. For the theory and general practice of these reactions the reader is referred to the scientific literature[2, 3, 4].

Just two reactions may be mentioned here, as they occur frequently in sizing and finishing problems. It occasionally occurs that the copper plating of the drop wires on the loom may come off, producing warp streaks of unknown origin. The copper present is in such small amounts

*Consulting Physicist and Chemist.

that only microchemical methods can trace it. The following method has been found practical by the writer:

COPPER-TEST WITH RUBEANIC ACID

First a spot paper is prepared by impregnating a piece of filter paper Schleicher and Schull No. 601 with a 0.5 per cent alcoholic solution of $(CS)_2$ $(NH)_2$ (Rubeanic Acid)* The spots upon the yarn in question are rinsed in a test tube into a small quantity of distilled water so as to produce an approximately neutral test solution. One drop of this solution is placed upon the spot paper described above, and held in front of the fumes from an ammonia bottle.

Copper present is indicated by a black circle or spot.

This test is so sensitive that small traces of copper such as produced by a copper distilling outfit, would be indicated. To eliminate this possible source of error, it is indicated to run a blank test on the distilled water that has been used in washing out the yarns.

SPOT TEST FOR PHENOL

This test is mentioned not only because it shows that spot tests can be used successfully for the detection of organic solutions and compounds, but also because a simple and positive phenol determination has long been wanted by the purchaser of sizing materials and other textile auxiliaries. Phenolic compounds while having good fungicidal properties, have been found by various investigators to interfere with the protective action of gelatine compounds present such as in rayon sizes and throwing compounds.

The compound suspected for phenols such as cresylic acid is put into solution with distilled water or alcohol. Solution should be as nearly neutral as possible.

A drop of the above solution is placed upon the filter paper or a spot plate. A drop of a 2 per cent aqueous solution of phosphomolybdic acid is added. If a drop of concentrated ammonium hydroxide is now placed on top of the previous preparation, a rich blue color indicates the presence of phenolic compounds.

The above mentioned two reactions are extraordinarily sensitive. Professor Feigl l.c. describes the limits of sensitivity of such tests by two characteristics, as follows:

(1) *The Limit of Concentration.* This is the ratio of one unit weight of material to the maximum number of unit weights of its solvent in which one unit weight of the test substance always gives a positive reaction. This is the unit of weight, the gamma (γ) which is identical with one millionth of a gram or one thousandth of a milligram (0.001 mg.).

(2) *The Limit of Identification.* This is by definition the smallest weight of a substance per macro-drop (0.05 ml.) of the solution to be tested which always gives a positive reaction of the substance.

The following sensitivities have been determined for the copper and phenol tests described above:

Copper—Limit of identification—0.03 gamma copper per 0.05 ml.

Limit of concentration—1 : 2,500,000.

Phenol—Limit of identification—2.0 gamma phenol per 0.05 ml.

Limit of concentration—1 : 5000.

The high inherent sensitivity of these reactions, the fact that they can be performed under certain conditions even directly upon the yarn or cloth in which defects are to be traced on very small amounts of areas present, yet requiring positive identification, make spot testing a valuable tool in the hands of the textile chemist.

*Obtainable from Eastman Kodak, Rochester, New York, or Eimer & Amend, New York, N. Y.

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TRADE NOTES • NEW PRODUCTS

• DOW RELEASE

The Dow Chemical Co., Midland, Michigan, has prepared a leaflet on Methocel, a water soluble cellulose ether, from which a superior film-forming material is said to be produced. Coatings manufactured from this material are said to be colorless, odorless, tasteless, transparent and stable to heat and light. It is stated that the properties of this interesting material seem to forecast unusual possibilities as an agent for dispersing, thickening, emulsifying, sizing and coating. Its applications to paper coating and sizing—to textile, cosmetic and paint fields as a thickening agent—its utility in preparation of pastes, sizes, water colors and paints—for thickening aqueous dispersions of casein and rubber latex—and as a medium for grinding and dispersing pigments, fillers and other paint materials—are all treated at length in the leaflet. Copies are available upon request.

• CIBA REVIEW

Copies of *Ciba Review,* Number 28, for November, 1939, have recently been issued. Featured in this issue is the subject of "The Textile Trades in Medieval Florence." Contents are described by the following titles: From the History of Florence; The Florentine Textile Industry of the Middle Ages; The Florentine Textile Trade in the Middle Ages; Historical Gleanings. Many interesting illustrations are used in carrying out the theme featured.

• LEIPZIG FAIR

Following its regular schedule, the Leipzig Trade Fair will be held from March 3rd to 10th, 1940. More than a score of countries will send their newest art and industrial products. The technical Division of the Fair will as usual be the great clearing house for every form of machinery, and will include the newest agricultural equipment. A new building has been added to the forty-two great structures already in use, making available over 4,000,000 square feet of exhibition space. The Spring Fair will be the 1983rd session of the historic exchange which has been held without interruption for more than 700 years.

Manufacture of Nylon Yarn Started

MANUFACTURE of nylon yarn in the first unit of the new plant at Seaford, Del., began on December 15, the du Pont Company has announced. Production of the yarn, scheduled originally for early in 1940, was advanced several weeks, due to the project being completed earlier than was anticipated when the construction work started January 20 last.

Operations will proceed gradually, gaining speed as experience develops with equipment and personnel. A single spinning machine was started on the 15th and the product minutely observed and proven satisfactory before other machines were put in operation. Capacity levels probably will not be reached for several months.

The plant is the first of its kind ever built, designed to fit an operation never before undertaken. The original unit is a single building, 1052 feet long and 272 feet wide. Slightly irregular in shape, it is essentially an elongated, single-story rectangle, extending from a six-floor tower at one end. The roof is flat, broken by terrace-like set-backs at different elevations. Large pent-houses accommodate air-conditioning equipment, with cowls and supply ducts coiling across them.

Manufacturing Process

The manufacturing process begins in the tower, reached by metal stairways. On the top level are huge insulated vessels of stainless steel. Below are other large receptacles, called autoclaves, extending through two floors of the building. Pipes, layer upon layer, line ceiling and walls, forming strange geometric patterns as they converge. On a lower level is a long line of shining metal canisters reaching from floor to ceiling. Each floor is devoted to a separate phase of the operation as the material flows downward through the crucibles of chemistry.

Electrical instruments mounted on panels guide the process with minute precision. Robot observers signal with flashing lights and chimes. Temperatures and pressures are recorded in vari-colored lines on paper discs. There are scales that print measures of weight on ticker-tapes similar to those in a stockbroker's office. Each aspect of the performance is carefully and systematically scheduled to the split second.

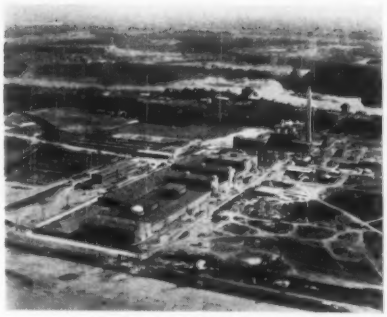
On the lower levels of the tower, intricate mechanisms designated as spinning units transform the nylon flakes into the slender, web-like filaments of nylon yarn. These units are grouped in batteries of twenty, set in horizontal wells through the floor. From the top, they resemble circular flour sifters, shaped to fit into the apparatus. They are kept filled with the flake-like nylon chips by mobile hoppers, traveling along an overhead rail. Here the material is melted then pumped under pressure through "spinnerets"—cups pierced with tiny holes. On the level below, the filaments appear, almost invisible individually as they become solid upon reaching the air. The fibers are again whisked from view down a narrow pipe-like chimney, where on the floor below they are wound on bobbins. The man-made harvest is complete as the strands spin merrily around the cylinder.

The sheerness of women's hosiery manufactured from nylon yarn is here demonstrated.

From this point, the yarn begins its progression through the various processing operations. The length of the plant is partitioned laterally into a series of long rooms, housing rows of textile machinery. Running at high speeds, these devices rotate spools and bobbins. The batteries of machines stand row on row along long aisles. Their mission is to twist and otherwise prepare the product for industrial purposes.

After a "pre-twisting" to facilitate handling, the bundle of fibers is drawn or stretched to impart the strength and elasticity peculiar to nylon. This is accomplished by a machine which stretches the yarn between two rotating devices going at different speeds. Chemists characterize this process as a rearrangement of the nylon molecules in an orderly, length-wise array.

Twisting of nylon yarn.



Aerial view of the new nylon yarn plant of the duPont Co. just outside Seaford, Delaware, looking south toward the Nanticoke River.

The yarn is then twisted, sized and lubricated in preparation for knitting and weaving. After final inspection it is packaged in skeins, cones or other forms and delivered to the shipping room at the building's extreme end, where a loading platform parallels the railroad tracks.

The plant will produce polymer, as well as yarn. Some of the polymer will be made into brush bristles and surgical sutures, among other articles, by the du Pont Plastics Department plant at Arlington, N. J.

The plant, when in complete operation, will produce approximately four million pounds of nylon yarn a year.

About 850 workers will be employed in operating the plant.

Opening of the plant climaxes a ten-year research program. Nylon fibers for textile uses, such as will be manufactured at Seaford, are wholly man-made and have no counterpart in nature. One of the most promising uses is in hosiery. Other textile applications, such as knit goods, underwear, and woven dress goods are the subjects of experimentation.

The nylon process is begun in the du Pont plant at Belle, West Virginia, which has been enlarged in the last year. The "intermediates" made at Belle will be shipped to Seaford.

The Seaford plant site is on the outskirts of the town. It comprises several hundred acres. Two miles of railroad spur have been built into the plant from the Pennsylvania tracks nearby. River transportation will be used for fuel, oil being barged up from the Chesapeake Bay. Other shipments will be made by rail or truck.

● PHI PSI CONVENTION

The 37th Annual Convention and Textile Exhibit of Phi Psi Fraternity will be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., on April 11, 12 and 13, 1940. The general committee is composed of the following: J. E. Fite, Jr., Charles W. Neeld, Jr., Thomas Gold, Benjamin K. Archer,

Theodore B. Hayward, Elmer T. Lewis, DeHaven Butterworth and Percival Theel. The general program will be as follows: Thursday—general registration and get-together at the Bellevue-Stratford; Friday—sightseeing trips and trips through some of the Philadelphia textile mills, luncheon at 1 P. M., informal smoker with entertainment in the evening; Saturday—general session of grand council, election and installation of officers in the morning, executive committee session in the afternoon and the banquet in the evening. The textile exhibits will be on view for the whole three days on the roof of the Bellevue-Stratford.

• NEW FLETCHER EXTRACTOR

Fletcher Works, Glenwood Ave. and Second St., Philadelphia, Pa., have recently put out a new High Speed Whirlwind Extractor with which, it is stated, it is possible to secure maximum drying in a minimum of time. The running time is said to be frequently reduced by one-half or more. In addition to its high speed, other special features claimed for this extractor include: absolute safety, stainless basket, greater stability, easy loading and unloading; less floor space, perfect smoothness, big capacity, maximum drainage, direct V-belt drive, automatic hydraulic brake, finger-tip control together with the regular Fletcher features of construction. A folder is available on request which describes the new Fletcher extractor in detail.

• DECEMBER TEXTILE RESEARCH

The papers and an outline report of the discussion of Wool Fiber Damage in Processing, which was the subject of a conference held last month by U. S. Institute for Textile Research, Inc., are published in the December issue of *Textile Research*. The conference declared the subject worthy of research, and authorized W. D. Appel, chairman of the Institute's Research Council, to appoint a committee to draw up a research program and to report on ways and means for conducting the project. The following committee has been appointed, and will meet in the near future at the National Bureau of Standards in Washington, D. C., where the Institute is conducting a research on Textile Drying: R. A. Lukens, vice-president, Continental Mills, Inc., Philadelphia, Pa.; Werner von Bergen, Director, Research and Control Laboratories, Forstmann Woolen Co., Passaic, N. J.; Mr. Hugh Christison, Arlington Mills, Lawrence, Mass.; E. D. Walen, Agent, Worsted Div., Pacific Mills, Lawrence, Mass., and Dr. Milton Harris, Director of Research, Textile Foundation Research Associateship, National Bureau of Standards, Washington. D. C.

The December issue also contains a full report of the proceedings and addresses at the Institute's tenth annual meeting, among the features of which were reports on the progress of researches being conducted by the Textile Foundation and the Institute.

Another notable feature of the issue is the progress report by Kenneth B. Fox, a research associate of the Textile Foundation, on Double Variation Method for the Determination of Refractive Indices of Textile Fibers. It indicates that there is very definite evidence that the new method will prove successful, and provide an accurate scientific means of fiber identification, of aid in fiber structure study, and of indicating fiber damage.

• RIGGS & LOMBARD RELEASE

Riggs & Lombard, Inc., Lowell, Mass., have just released a circular entitled "The Fleet Line Review of Progress." It is stated that the nucleus of the present Fleet Line of textile wet processing equipment was launched in 1932. There are listed thirty innovations in design and construction which first appeared in R. & L. machines. Complete descriptions of the line manufactured today, together with photographs, are attractively presented. Copies of the circular are available upon request.

OBITUARY

HUGO KOBLENZER

HUGO KOBLENZER of 1671 Boulevard East, North Bergen, N. J., long prominent in the textile chemical business, died December 2nd at the Polyclinic Hospital, New York, after an illness of two weeks. He was 59 years old, born in Constance, Germany, and came to the United States in his early youth, settling in Chicago where he became a citizen of this country at the age of 21. He studied at the Universities of Chicago and Cornell.

In 1908 he organized the New Brunswick Chemical Co. in New Brunswick, N. J., retiring from active business in 1920. From 1920 to 1925 he resided in Europe where he was associated with plants in Milan, Italy; Rouen, France, and Freudenthal, Czechoslovakia. He returned to this country to become an officer of the Standard Chemical Products, Inc., and Standard Agricultural Chemicals, Inc., in Hoboken, New Jersey.

His wife having predeceased him, he is survived only by a daughter.

FRANK LUDLAM

FRANK LUDLAM, assistant secretary and assistant treasurer of the International Nickel Co., Inc., died on December 8th at his home at 1130 Park Avenue, New York City, after a long illness.

Mr. Ludlam was born at Bloomfield, New Jersey, on November 3, 1873. He attended the Lyons School in New York City and the Columbia School of Mines, where he studied architecture. After spending several years in architecture and real estate, Mr. Ludlam took a position with the Carnegie Steel Company at Pittsburgh. In March, 1903, he came to the International Nickel Company.

He was a member of the Columbia University Club and the Kane Lodge F. and A. M.

Surviving are two sons. Mr. Ludlam's wife died in 1938.

• CLASSIFIED ADVERTISEMENTS •

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Chemist with over 25 years' experience, plant and laboratory, bleaching, dyeing, printing, finishing all types textiles, all classes dyes. Supervise research, development. Write Box No. 220, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

Additional Classifieds on page XIV

POSITION WANTED: Chemist desires position. Twenty-seven years' experience. Fast colors, new finishes, all types laboratory work, yarn, piece goods, cotton or rayon. Excellent health. Write Box No. 212, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Hosiery dyer, 25 years' experience in two leading mills on silk, silk mixed and rayon. Can produce desired finishes at minimum cost. Capable taking full charge. Would consider assistant to head dyer. Age 44. References. Write Box No. 219, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

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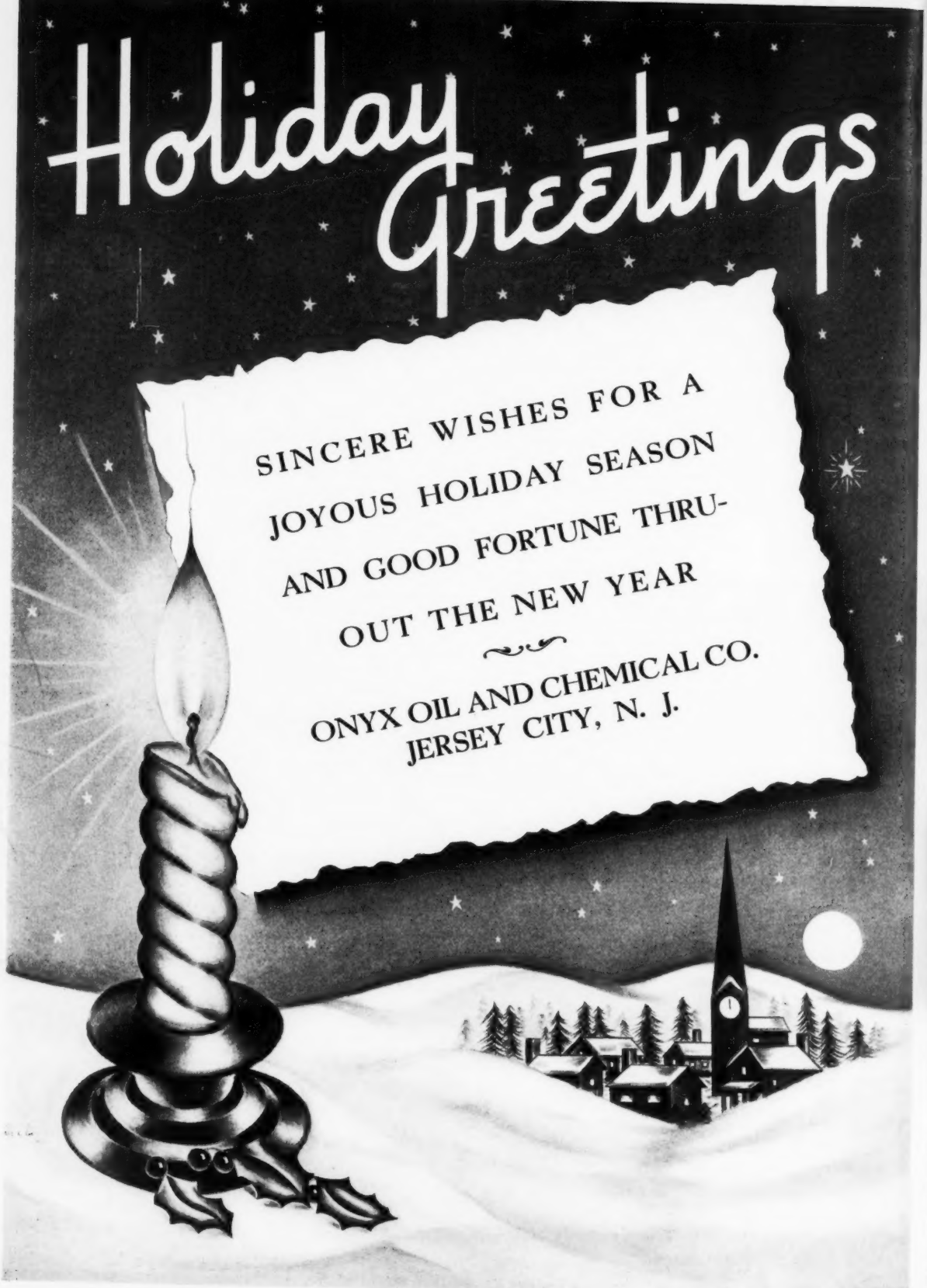
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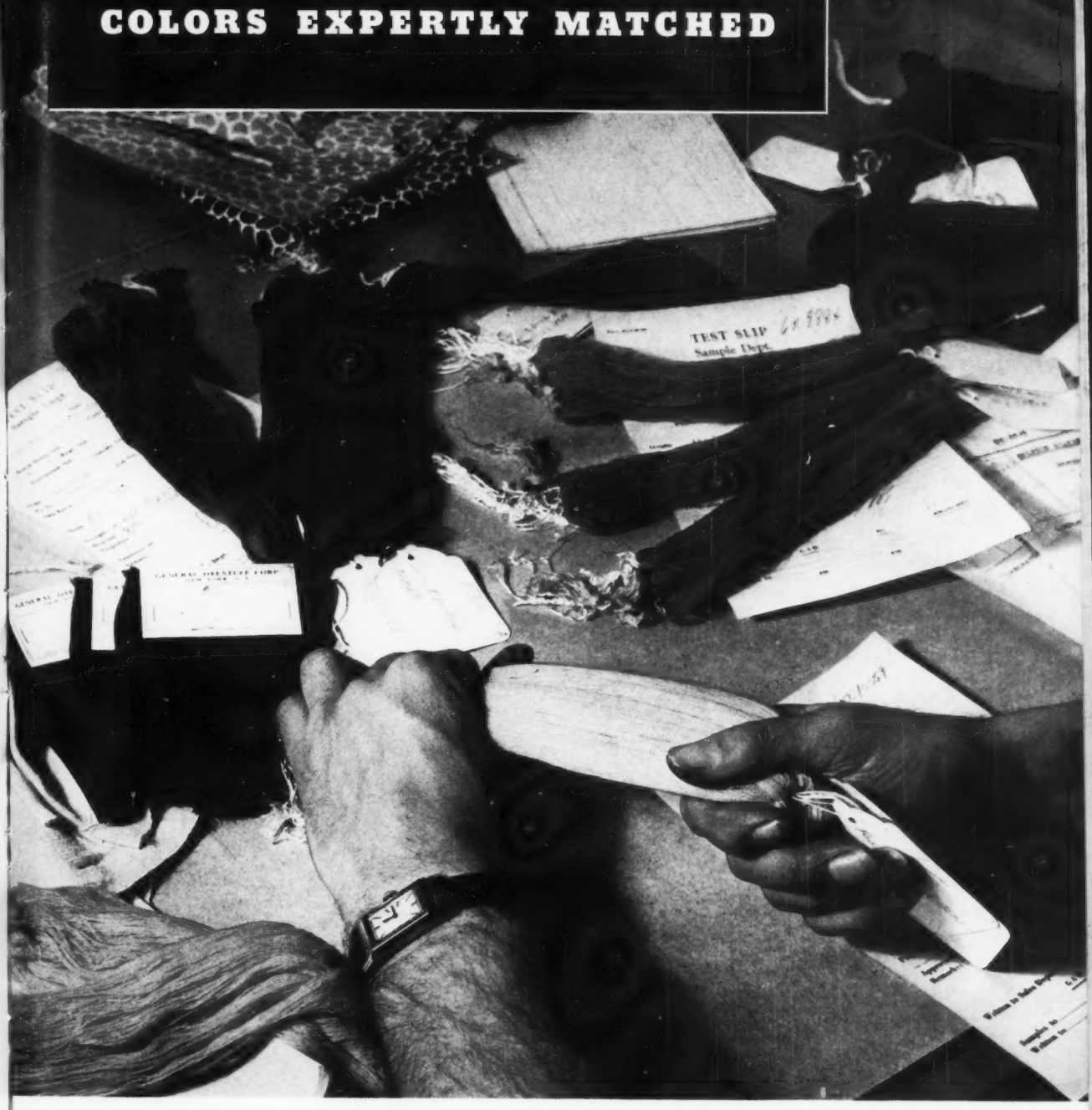

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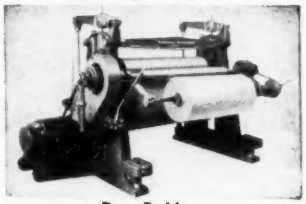
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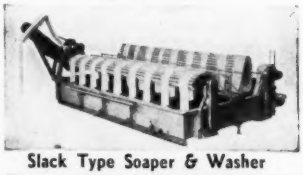
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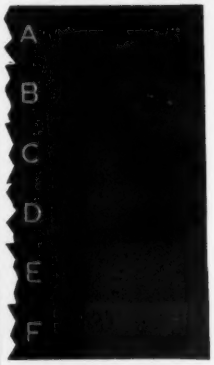

Here Illustrated

● This dyed purple fabric was exposed in steps in a Fade-Ometer. Side strip is unexposed color; A to F are consecutive exposures.

A had	3	Fade-Ometer	Hours		
B "	6	"	"	"	
C "	9	"	"	"	
D "	12	"	"	"	
E "	15	"	"	"	
F "	18	"	"	"	

The Fade-Ometer shows you in a few hours just how any dyeings will act when subjected to regular usage in sunlight.

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Index to Advertisers

American Aniline Products, Inc.	Third Cover	International Nickel Co., Inc.	
American Cyanamid & Chemical Corp.	Second Cover	Jordan Jr. Mfg. Co., W. H. & F.	XVIII
American Dyewood Co.		Kali Manufacturing Co.	XIV
Arkansas Company	VII	Kelco Co.	
Arnold-Hoffman & Co., Inc.		Laurel Soap Mfg. Co.	XII
Aqua Sec Corp.		Mathieson Alkali Works	
Atlas Electric Devices	XIV	Merco Nordstrom Valve Co.	
Bick & Co., Inc.	XV	National Aniline & Chemical Co., Inc.	
Blickman, Inc., S.		National Oil Products Co.	
Bosson & Lane, Inc.	XII	Nyanza Color & Chemical Co.	XV
Calco Chemical Co.	XIV	Onyx Oil & Chemical Co.	IV
Campbell & Co., Inc., John	VI	Perkins & Son, Inc., B. F.	
Carbic Color & Chemical Co.	VIII	Procter & Gamble	
Carbide & Carbon Chemicals Corp.		Reichhold Chemicals, Inc.	
Ciba Company, Inc.	III	Riggs & Lombard	
Colgate-Palmolive-Peet Co.		Rohm & Haas Co.	XIII
Commonwealth Color & Chemical Co.		Royce Chemical Co.	Back Cover
Du Pont de Nemours & Co., E. I.		Sandoz Chemical Works	
Dyestuff Division		Scholler Bros., Inc.	
Fine Chemicals Division	X	Solvay Sales Corp.	XIII
R. & H. Chemicals Dept.		Stein, Hall & Co., Inc.	
Franklin Process Co.		Union Carbide & Carbon Corp.	
Gardinol Corp.		Van Vlaanderen Machine Co.	XII
Geigy Company, Inc.	Front Cover	Vellner, Eugene	XIV
General Dyestuff Corp.	V	Wallerstein Co., Inc.	
General Chemical Co.		Watson Park Co.	
Hercules Powder Co.		Wolf & Co., Jacques	
Naval Stores Dept.	XI	Young Aniline Works	XVII
Providence Drysalters Division		Zinsser & Co.	XVII

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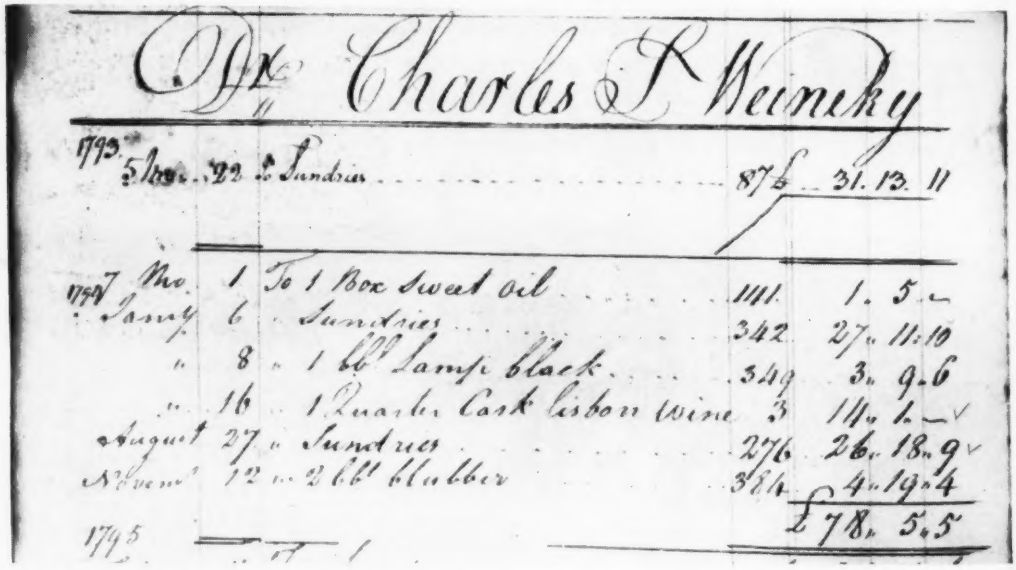
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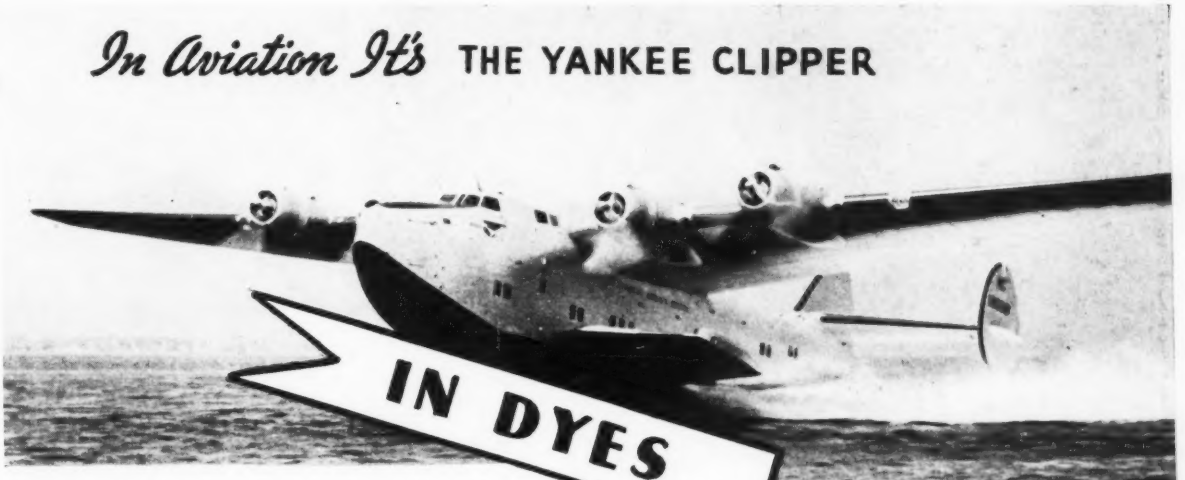

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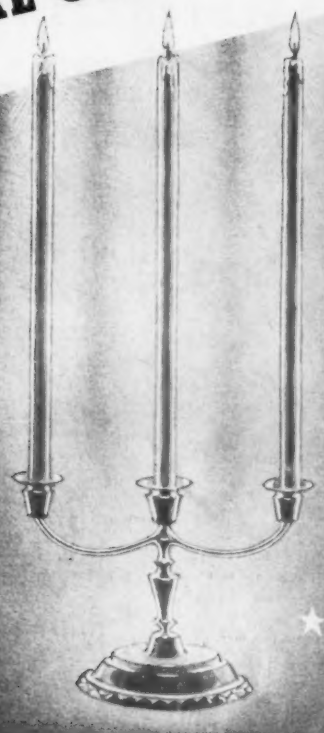
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